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From farm to petri dish: cell-based meat's progress to market

A multiple case study on the importance of strategic partnerships in an early R&D phase

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Abstract

Sustainability, population dynamics and health issues are some of the greater challenges the global society faces today. Meat consumption has emerged as one of the reasons behind the cause and effect of these challenges. There is a growing consensus amongst researchers, industry stakeholders and decision-makers that there is a need to transition into more sustainable alternatives to meat. As a response, there has been an increase in food tech innovations in the last few years with cellular agriculture at the forefront. Cell-based meat has emerged as an innovative field that has the potential to provide a solution.

Cell-based meat does face challenges of their own in need of resolving to commercialize and compete at a competitive price. Thus, what challenges the cell-based meat industry faces in the R&D phase were investigated through a multiple-case study. Emphasis is given to how strategic alliances and partnerships can aid in resolving these issues. Three cell-based meat companies were interviewed to shed light on the matter as well as an expert opinion. It was found that the industry faces challenges in three main categories: technical, regulatory and market challenges. Cell-based meat companies seek strategic partnerships and alliances to access resources and knowledge that help them overcome all challenges. However, how partnerships are formed and with whom depend on the imposed risks and uncertainties, in particular, to protect intellectual property and competitive advantage. In an early R&D phase, companies do not engage in collaboration with other cell-based meat companies, but rather seek collaboration with the traditional meat industry to access market knowledge and distribution networks. There is, however, a willingness to partner up with other cell-based meat companies to solve legal-political barriers, set industry standards, and build the foundation for the industry. Cell-based meat could eventually prove to become a benchmark for new food technologies that are driven by the vision to provide healthier, safer and more sustainable food alternatives.

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Vocabulary list

Bioreactor: A device or apparatus in which living organisms and especially bacteria synthesize useful substances (Merriam-Webster). Used in the production of cell-based meat when stem cells are placed in the bioreactor in order to grow new cell tissue (Mattick, 2018).

Cellular agriculture: “Cellular agriculture is a method of agricultural production enabling the growth of meat, eggs, and leather in cell culture rather than raising and slaughtering livestock. Cellular agriculture applies methods of tissue engineering to food production to make meat and dairy products that are molecularly identical to those made via conventional methods.” (Kim, 2016).

Industrial farming: a large industrialized farm; a farm on which large numbers of livestock are raised indoors in conditions intended to maximize production at minimal cost. (Merriam-Webster)

Nutrient serum: Cell-culture media which is used in the process of producing cell-based meat to feed the cells with the right nutrients to allow for growth. The culture mimics the conditions that the cells would experience in animal tissue. (Guoqiang et al. 2020). Initially, fetal bovine serums were used in research labs that are extracted from animals, but recently non-animal serums are increasingly being used (Lucchesi, 2019).

Research and Development: R&D is described as the pursuit of knowledge, technology and innovation within an organization. R&D is a tool for a firm to achieve a competitive advantage by evolving technology through innovation and value-added services (Akhilesh, 2014).

Keywords:

Cellular agriculture; cell-based meat; cultured meat; R&D; innovation; biotechnology; meat industry; intellectual property; strategic partnerships; strategic alliances.

Table of contents

1. Introduction	7
1.1 Problematization	10
1.2 Objectives	11
1.3 Delimitations	11
1.4 Disposition	12
2. Literature review	13
2.1 The cell-based meat field	13
2.2 Strategic alliances and partnerships	14
2.3 Theories behind the motivation of strategic alliances	17
2.4 Risks and challenges of strategic alliances and partnerships	21
2.5 Key take-aways from the literature review	23
3. Methodology and Research Design	24
3.1 Data collection	25
3.1.1 Primary data: Interviews with case companies	25
3.1.2 Interview overview	27
3.1.3 Secondary data	28
3.2 Method for data analysis	28
3.3 Research quality	29
4. An industry outline	32
4.1 The cell-based meat industry	32
4.2 The rationale for cell-based meat	32
4.3 The competitive landscape	33
5. Understanding the industry challenges	35
5.1 Technical challenges to produce cell-based meat	35
5.2 Regulatory and legislative challenges	37
5.3 Market challenges	41
6. Current status: strategic partnerships and alliances today	42
6.1 Investment grade	42

6.2 Partnerships for technical challenges	43
6.2.1 Partnerships with Research Organizations and Universities	44
6.2.2 Industry partnerships	45
6.3 Alliances for regulatory challenges	46
6.4 Collaborations for market challenges	47
7. Results and analysis - Empirical data findings from interviews	49
7.1 Theme A: Challenges	49
7.1.1 Technical challenges	49
7.1.2 Regulatory challenges	52
7.1.3 Market challenges	54
7.2 Theme B: How do the case companies view strategic partnerships and alliances?	56
7.2.1 Partnerships for technical challenges	58
7.2.2 Collaborations for regulatory challenges	61
7.2.3 Partnerships for market challenges	62
8. Concluding remarks	67
9. References	77
Appendix A: Interview guide	92
Appendix B: Presentation of thesis	93

List of Figure and Table

Figure 1: Method model25
Table 1: List of Interviewees.....27

1. Introduction

The greater challenges for the global society today inevitably involve sustainability, population dynamics, as well as health issues (FAO, 2009; WEF, 2020). Over the last few years, the world has seen a tremendous rise in public awareness on climate change (Bennett, 2019; Fillion, 2019), which has put sustainability issues on the agenda for decision-makers, corporations, and individuals worldwide. The World Economic Forum lists the top global risks for 2020, both in terms of the highest likelihood and highest impact, as climate action failure along with other environmental risks (WEF, 2020). Climate change is a result of human activity, which then follows that changes in demographics play a key part.

Population dynamics give rise to both societal opportunities and various challenges, one of which is rapid population growth (Bloom, 2020). The middle class worldwide is expected to reach 5.5 billion by 2030, with 87 % of that growth is forecasted to occur in Asian countries; a megatrend that has received the attention of researchers for years (European Commission, n.d.). Heightened living standards imply stronger purchasing power, which changes consumer behavior patterns and preferences (European Commission, n.d.). The world population is experiencing continuous growth, though the growth is dispersed differently across nations, which gives rise to a shortage in the world's food supply (FAO, 2009). This matter, will in turn, determine prerequisites for sustainable development going forward.

The World Economic Forum (2020) also points to the interconnectivity between environmental issues and the risks for food crises on a global scale. FAO (2017) lists the top challenge for the future of food and agriculture as “sustainably improving agricultural productivity to meet increasing demand”. The trade-off seems almost daunting; how can the world ensure food supply for a growing population expected to reach 9.7 billion by 2050 (UN, 2019), while not compromising on the commitment of the 2030 Sustainable Development Goals¹?

¹ Specifically the goals of goal 2: no hunger, goal 3: good health and well-being, goal 12: responsible consumption and production, goal 13: climate action, and goal 15: life on land. (Sustainable Development Goals, n.d.)

Few industries have quite the same embedded complexity as the food sector (Eriksson, 2020). A common denominator that rises when one surveys these challenges – from sustainability to population dynamics – is the meat industry (Froggatt & Wellesley, 2019). The United Nations filed a report that establishes that meat consumption needs to reduce in order to fight climate change and reduce pressures on natural resources (Chestney & Nebehay, 2019). The report also found it would improve biodiversity, health and food safety (Chestney & Nebehay, 2019). There is a growing consensus amongst many researchers, environmental organizations, public health authorities and civil society alike that there is a need to transition into more sustainable and resource-efficient alternatives to meat as its negative externalities are detrimental (Froggatt & Wellesley, 2019). Not only are the consequences of livestock production damaging to the climate in terms of emissions, water and areal usage, but red meat consumption also connects to a variety of health risks (WCRF, 2018).

Meat alternatives could thereby also contribute to improved public health as well as to reduce the use of antibiotics, commonly found in industrial meat production, which can combat the spread of antibiotic resistance (Froggatt & Wellesley, 2019). Nevertheless, the demand for meat continues to surge, further driven by changes in consumer preferences and improved living standards in emerging markets (World Economic Forum, 2019). The demand is explained by the proven correlation between economic advancement and a country's meat² consumption per capita (Our World in Data, 2017). How do we satisfy a growing meat demand, while simultaneously reducing our dependence on animal agriculture to ensure we achieve the sustainability goals?

A solution to these challenges requires multilateral, cross-organizational, and transdisciplinary collaborations (Froggatt & Wellesley, 2019). Old solutions might not suffice to change the status quo (Froggatt & Wellesley, 2019). These challenges are in one way or another embedded risks for most industries today, though the food and agricultural sector is inevitably more affected than others (FAO, 2017). In response to these challenges, industries have turned to innovation for answers, which FAO (2017) points out as one of the main drivers of change in the 21st century. New technological innovations have also given rise to new industries that envision their

² This study's definition of meat excluded fish and seafood, but included red meat and white meat such as poultry.

solutions will support the necessary changes needed. The cell-based meat industry is one of them.

Cultured meat, cell-based meat, clean meat, cultivated meat, in vitro meat, lab-grown meat- a loved child has many names, as the Swedish saying goes. The cell-based meat industry has spurred out of a vision to supply the market with a meat alternative that corrects the many faults of the global meat industry; faults that correlate to the most pressing global issues of today. The industry has emerged from the ever-growing field of cellular agriculture (Penn, 2018). Thus, it differs from plant-based meat, which is created by the extraction of protein from natural sources, such as beans or peas (Penn, 2018). The field is defined by Kim (2016) as:

Cellular agriculture is a method of agricultural production enabling the growth of meat, eggs, and leather in cell culture rather than raising and slaughtering livestock. (...) Cellular agriculture applies methods of tissue engineering to food production to make meat and dairy products that are molecularly identical to those made via conventional methods. (n.p.)

The laboratory process stemmed from the field of regenerative medicine and was first pioneered by NASA in the early 2000s as a design process that could aid food supply for long term space flights (Guoqiang, Xinrui, Xueliang, Guocheng, Jingwen & Jian, 2020). However, at this stage, muscle tissue was grown in Petri dishes and did not have the capacity that start-ups have enabled today. The first patents issued back in 1995 were the inception of an innovation area that proclaims it can have a profound impact on the way people consume meat in the future (Lawton, 2020). The race has been on to innovate a meat alternative ever since, and it accelerated after Mosa Meat prototyped the first ever lab-grown burger in 2013 (Bunge, 2018). All companies that currently pursue cell-based meat prototypes are still in a pre-commercialization phase (Kateman, 2020). A key component for acceleration in the R&D phase, according to theory, is the importance of strategic partnerships and alliances to advance innovation development (Todeva & Knoke, 2005). Access to resources and capabilities, knowledge sharing and creation as well as risk-sharing are amongst the reasons why innovators could see strategic partnerships and alliances as key to gain the competitive muscle needed to advance their innovation development (Das & Teng, 2000). As the development of cell-based meat is instead a matter of *when* and not

if, it raises some interesting questions about which challenges are a hindrance to the market, and how strategic collaborations could aid to resolve them.

1.1 Problematization

Innovations and investment in meat alternatives have skyrocketed in the last decade, which indicates there is a wide-spread interest to see more sustainable options alter the competitive landscape for the meat industry (Froggatt & Wellesley, 2019). The cell-based meat industry is a new emerging industry that has made significant progress, which hints to the commercialization of cell-based meat products in the not too distant future (Stephens, Sexton & Driessen, 2019). Academic literature and research conducted within the field of cellular-based meat seemingly cover biotechnology, engineering or agricultural perspectives, which focuses on the technicalities of production. The business studies written on the subject are limited and mostly concern the end consumer market from a consumer behavior or marketing perspective by conducting studies on consumer acceptance or discussing innovator's vision and claims (Bryant & Barnett, 2018). Even though these are undeniably important topics that will be of high relevance going forward, it also reveals the gap in business literature that accounts for the state of the industry as of now, which is in, to a varying degree, the R&D phase (Kateman, 2020). No paper has extensively outlined the challenges the industry has from a strategy perspective – and by which means they collaborate to solve them.

As the field moves from an academic research space into what is to become an industry on its own, the business perspective is of heightened importance (Stephens, Sexton & Driessen, 2019). External stakeholders are crucial to have on board if these innovations are to commercialize; start-ups rarely grow into companies on their own as they lack sufficient funds and distribution channels (Segers, 2015). As prior research within biotechnology has established the importance of strategic partnerships and alliances within an early R&D phase (Segers, 2015), it is motivated to study what the state of strategic partnership and alliance situation is for the cell-based meat industry. Therefore, in order to forecast industry potential, there is a need to examine which steps are necessary to take for commercialization – and which challenges stand in its way. If present strategic collaborations are analyzed, this could indicate where there is a gap that future partnerships could fill in order to accelerate product development and time to market.

1.2 Objectives

In light of this brief introduction, the thesis aims to investigate the importance of strategic partnerships and alliances within the early R&D phase of highly innovative cell-based meat companies through a multiple-case study. In particular, it aims to contribute to academic research within the cell-based meat field by providing new insights from the industry that are unaccounted for. Furthermore, it aims to address if established theory on strategic partnerships and alliances holds for this new industry too. The insights provided by industry stakeholders could help project future needs for strategic partnerships and alliances. The results can be valuable to industry stakeholders to realize where there lies potential to enter partnerships, which challenges can be solved through collaboration and to receive a state of the industry report from an academic point of view.

In order to address this purpose, we pose the following questions:

R1: What are the challenges that cell-based meat companies face during their R&D phase?

R2: How do these challenges motivate firms to seek strategic partnerships and alliances?

1.3 Delimitations

Due to the business focus of the thesis, there will be no in-depth analysis of the technical production of cell-based meat. The industry outline reviews the different methods used to grow cell-based meat, but this thesis will refrain from comparisons of the different technologies. Furthermore, neither an extensive macroeconomic analysis nor a comprehensive policy debate is present. A handful of macroeconomic factors are discussed, but admittedly it will not be able to cover all. As such, other factors that may perhaps affect either the meat industry or the rise of the cell-based meat industry are beyond the scope of this thesis. As most cell-based meat companies operate within the European and U.S. market, there will be a focus on these regions in the thesis. However, the findings of this thesis can apply to a broader global context.

1.4 Disposition

The thesis is structured in the following order. After the above brief introduction, a literature review is presented with theories on the topic of R&D, strategic alliances and partnerships. A method section follows that describes the structure of the thesis and how the research is conducted. Due to the novelty of this field, a detailed overview is provided of the cell-based meat industry. The secondary data is then followed by primary data and analysis of the empirical findings from the conducted case studies and interviews. Lastly, the findings are discussed in terms of relevance, applicability and implications for further research.

2. Literature review

This literature review aims to highlight the traditional external R&D sources, and benefits as well as risks of strategic collaborations in different forms during the R&D phase. This theoretical focus is chosen as there is no extensive research or theory present for the cell-based meat field. Research insights from the biotechnology and the high-tech sector, in particular, is brought up due to its proximity to the cell-based meat field. Specific data about the cell-based meat industry is instead present under the secondary data sections.

2.1 The cell-based meat field

The cell-based meat field is argued to have experienced a two-stage development, according to Stephens, Sexton and Driessen (2019). The first wave, from around the millennium up until 2013 when Mark Post exhibited the first cultivated hamburger, was an era where the field existed mostly as university research within the biomedical academic space (Stephens, Sexton & Driessen, 2019). At that time, the research was not intended for commercialization but instead sprung from altruistic visions of solutions that could improve the environment and animal welfare standards. The field was unable to move into a proper start-up stage as they struggled to receive funding since the area could not be strictly categorized into existing research fields (Stephens, Sexton & Driessen, 2019).

The second stage marked from 2013 onwards is recognized by the establishment of a start-up culture, where some university research projects transitioned into start-ups on their own – with the help from venture capitalists that acknowledged the field when it gained wider attention (Stephens, Sexton & Driessen, 2019). Due to the novelty of the field, and difficulties in attracting investors as of the unclarity of which field this new industry belonged to, start-ups sought funds from tech accelerators (Stephens, Sexton & Driessen, 2019). Tech-oriented venture capitalists, especially in the Silicon Valley region, had during that time found interest in food technology (Stephens, Sexton & Driessen, 2019). This interest derived because climate change and global food security were prioritized issues on the agenda, which proved great timing for the cell-based meat start-ups that pitched for funds (Stephens, Sexton & Driessen, 2019).

As the two-stage development hints at this new emergent industry, it is difficult to categorize into existing fields strictly. However, it has similar characteristics to both the biotechnology field and high-tech sector. For that reason, theories and research within both academic fields are reviewed to assess applicability to the cell-based meat industry. According to Akhilesh (2014), R&D is essential for technology-intensive firms for their survival and growth. Som (2012) further explains how R&D has been regarded in the past as a driver for growth in organizations and economies. However, authors such as Srholec and Verspagen (2008) have undermined the importance of R&D. They argue that within a high-tech industry, there are a variety of innovative strategies, and many firms have experienced success without using specific R&D practices (Srholec & Verspagen, 2008).

The challenges inherent with the need to stay competitive and ahead of the curve in terms of capabilities and knowledge generation for a competitive advantage is especially important for the biotech industry, which is a capital and resource-intensive industry with high barriers to entry (Segers, 2015). Rudny (2016) highlights that the need to enter strategic alliances is especially paramount for start-ups in the biotech field, as they lack the funds needed for the complex technology and usually face sunk costs in the product development process. Could the cell-based meat industry leverage similar benefits by entering strategic alliances for growth, as has been documented for start-ups in the biotech or high-tech sector?

2.2 Strategic alliances and partnerships

There are a variety of different types of strategic alliances that firms can involve themselves in. Narula (1999) suggests the term strategic partnership is comprehensive and that several different types of partnership agreements lie within the definition. Das and Teng (2000) explain strategic partnerships as “voluntary cooperative inter-firm agreements aimed at achieving competitive advantage for the partners”. A definition set out by Gulati (1998) defines strategic alliances as “voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies or services” (Gulati, 1998, p. 293). Gulati (1995) further states that a strategic alliance is an independently initiated and intentional relationship between two different parties. The concept of strategic alliances gained popularity within international business and academia alike in the 1990s, in part as a result of a rapidly changing business environment,

increased costs for product development and a more challenging competitive climate (Kelley, 1994). Strategic alliances emerged as a fit solution when firms tried to puzzle together the pieces of quicker market entry, higher quality demands and changing consumer preferences (Kelley, 1994). Russo and Cesarani (2017) view the formation of strategic alliances as a response to market challenges caused by globalization.

Oxley and Sampson (2004) state that firms that undertake R&D activities and projects could benefit from allying to access technical knowledge. Narula (1999) agrees that strategic alliances are preferable to complete the process entirely in-house, especially in knowledge-intensive industries that are pressured by rapid advancements in technology. Hagedoorn and Schakenraad (1994) recognize that there is a need to seek strategic technological alliances to monitor appearing unrelated fields. This is because there are difficulties for a single firm to attempt to integrate both horizontally and vertically, which would be less efficient than to seek collaboration for it (Hagedoorn & Schakenraad, 1994). A firm can decide whether to use in-house or external sources of R&D by identifying gaps in a firm's know-how (Akhilesh, 2014). Firms can use external R&D capabilities from suppliers, competitors or other organizations (Pisano, 1990). In new and changing technical environments, it is important to have a capable R&D team, preferably in-house as this serves as essential know-how for firms (Pisano, 1990). A discussion of in-house versus external sources of R&D could seem like a polarized choice, however, Powell, Koput and Smith-Doerr (1996) argue that these decisions are not mutually exclusive but co-exist especially for biotech companies. Internal knowledge creation is equally important as external collaborations for know-how, and that both ought to be pursued to achieve competitive capacity (Powell et al. 1996).

According to Vilkamo and Keil (2003), technological advancements and the rapid increase of product development in high-tech industries amplify the need for companies to seek strategic alliances. Strategic alliances could be a key success factor for firms in high-tech industries as firms could utilize collaborative advantages to manage fast-changing technological environments (Das & Teng, 2000; Yasuda, 2005). Alliances allow firms to cope better with external business environments by balancing their internal weaknesses with their partners' strengths (Russo &

Cesarani, 2017). They provide access to critical resources and could be of importance for a firm to maintain and gain a competitive advantage (Cobeña, Gallego, & Casanueva 2017).

Myteka (1990) argues that one of the strategic partnership forms most commonly found in R&D processes are inter-firm cooperative agreements. Todeva and Knoke (2005) agree to a similar definition of R&D Consortia as a form of a strategic alliance that usually takes place in fast-changing technological environments. These R&D strategic alliances can be of great benefit when dealing with highly uncertain technologies and also to overcome legal-political barriers (Todeva & Knoke, 2005). Firms that are involved in R&D partnerships could achieve technological breakthroughs that would benefit both parties of the agreement (Todeva & Knoke, 2005). However, Narula (1999) points out that strategic partnerships can vary in form depending on their underlying motivation, whether it is strategic or cost-efficiency that is the main driver. Though non-equity forms are the most common, as suggested by Myteka (1990), Narula (1999) points out that there are equity partnerships as well found in the R&D phase.

Narula (1999) argues that what sets an R&D alliance apart from a generic strategic alliance is partly because of the short-term objective to reach completion of tasks as its end goal, rather than a long-term collaboration under the evolution of the business. Myteka (1990) however points out that other generic strategic partnerships generally do not undertake a mutual development of the know-how, but instead opt for “a one-way transfer of technology” (Myteka, 1990, p. 296). What sets an R&D partnership apart from other modes of collaboration, such as licensing or joint venture, can be concentrated on three factors; knowledge production and sharing, little to none equity ownership, as well as its long-term time frame (Myteka, 1990). The main argument for undertaking strategic alliances in the R&D phase instead of more contractual forms of collaborations points to the inherent uncertainty in the process as well as a high degree of tacit knowledge, which makes hierarchical agreements hard to formulate (Narula, 1999).

Furthermore, the parties involved usually see it as a long-term commitment to grow together rather than to pursue a strategic investment solely, perhaps of opportunistic nature (Myteka, 1990). To which degree there is a high number of strategic alliances embedded within an industry could in part depend on whether other players have entered collaborations, so-called

demonstration effect, as well as the compounding effect of network externalities (Mody, 1993). Network externalities are the notion that the larger the network becomes, the greater the value creation will be for those involved in the network (Mody, 1993). Thus, in order for partnerships within an industry to gain momentum, there can be a need for a snowball effect.

Cellular agriculture originally stems from the biomedicine and biotechnology field. Thus it can be relevant to see what research has covered on the topic of strategic alliances and partnerships within that area. Segers (2013) highlights that the strategy of most traditional collaborations within the biotech industry consists of smaller firms or start-ups performing R&D development for larger firms, which results in a one-way transition of technology (Mody, 1993). Segers (2013) further argues that this very hierarchical structure of a strategic partnership form has been exchanged in favor of open innovation. The open innovation approach has opened up alternatives for smaller firms to collaborate with larger firms, investors and universities in a new way that allows them to stay competitive (Segers, 2013). The open innovation approach emphasizes long-term knowledge generation for a mutual benefit, in favor of the short-term financial advantages of intellectual property acquisition (Segers, 2015).

The biotech industry also struggles with funding, as competition is fierce and the threshold for companies to invest in the field is deemed high, as they can be reluctant to invest in technology they do not fully comprehend (Rudny, 2016). From a venture capitalist's perspective, there are regulatory challenges for biotech innovations that present uncertainty (Baeyens, Vanacker & Manigart, 2005). The long lead time to market also means a very distant ROI³ pushed to an uncertain future (Baeyens, 2005).

2.3 Theories behind the motivation of strategic alliances

Theories such as the resource-based theory and transaction cost theory can explain why companies engage in strategic alliances. The resource-based view claims that firms enter strategic alliances to access critical resources that they do not possess (Das & Teng, 2000). A firm's resources are characterized by Daft (1983) as any assets, information, capabilities,

³ Return on investment

organizational process and firm attributes owned by a firm that contributes to efficiency within the firm. A firm has a heterogeneous resource base if their resources are firm-specific, immobile and are not substitutable and imitable (Das & Teng, 2000). It is this heterogeneity of resources within firms that enables a possible competitive advantage and value-creation for the firm, which promotes strategic alliance formation (Das & Teng, 2000).

The resource-based view, as interpreted by Das and Teng (2000), argues that the objective for a firm to enter into a strategic alliance stems from the potential value-creation of combining both the firms' resources together. Yasuda (2005) further states that firms can be seen as bundles of resources and that firms enter strategic alliances when in need of resources that cannot be acquired through market exchanges. Eisenhardt and Schoonhoven (1996) support this by stating that firms are more likely to seek out strategic alliances either when they need valuable resources or if they possess them. Firms in the same industry may possess different strategic resources, and if the resources are not entirely mobile, this will contribute to a sustained competitive advantage (Barney, 2000).

The resource-based view can also be applied to new product development within high-tech industries. When firms in high-tech industries engage in new product development, they can benefit from resource access through alliances (Ma, Yang, Yao, Fisher & Fang, 2011). Strategic alliances could contribute to new product development success by accumulating a variety of resources from the alliance partners (McGee, Dowling & Megginson 1995). However, the ability to share resources within an alliance and successfully integrate them depends on the characteristics of the product development process (Lewis, Welsh, Dehler & Green, 2002).

The traditional transaction cost theory, on the other hand, centers around how firm decisions can minimize transaction costs (Das & Teng, 2000). Hoffmann and Schlosser (2001) state that firms should engage in strategic alliances if fixed and continual transaction costs can be reduced. When transaction costs are relatively high, a firm would preferably internalize its activities (Das & Teng, 2000). If transaction costs are low, and production costs are high, a firm could benefit from external exchanges (Das & Teng, 2000). However, strategic alliances are a combination of both externalizing and internalizing these activities and exchanges (Das & Teng, 2000).

Therefore, a firm can be advised to engage in strategic alliances: “when the transaction costs associated with an exchange are intermediate and not high enough to justify vertical integration . . .” (Gulati, 1995, p. 87). The transaction cost theory emphasizes the establishment of trust between the partners in the alliance (Hoffmann & Schlosser, 2001). A lack of trust will increase the risk of opportunistic behavior and thereby increase the need for safeguards, which results in increased transaction costs (Hoffmann & Schlosser, 2001). Furthermore, Hoffmann and Schlosser (2001) state that inter-organizational trust will lessen the need for control, which in turn will result in lowered transaction costs. The success of an alliance will partly rely upon how behavioral uncertainty is minimized and thereby the need for control (Hennart, 1988).

In R&D alliances, there is usually a high degree of transactions between the partner firms (Lioukas & Reuer, 2020), which is why the transaction cost theory can be applied to this phase. The transactions can involve a variety of activities and complex agreements, which could foster opportunistic behavior from partner firms (Lioukas & Reuer, 2020). R&D alliances can alleviate inter-firm transaction cost risks by organizing less complicated alliances, narrowing the scope and limiting the variety of functional activities within the alliance (Lioukas & Reuer, 2020). These factors will limit the transactions between the different partner firms and thereby reduce the transaction cost risks (Lioukas & Reuer, 2020).

The resource-based theory and transaction cost theory have been noted as the most influential reasons as to why companies engage in strategic alliances (Sørensen & Reve, 1998). There are however other theories that explain the motivation behind seeking strategic alliances, such as the learning argument (Mody, 1993) as well as the business and competitive strategy view (Hoffmann & Schlosser, 2001; Todeva & Knoke, 2005). Mody (1993) insists that learning is one of the main arguments for organizations to enter an alliance. As technology advances and competition toughens, it becomes ever more important for firms to complement their existing knowledge to remain at the forefront (Mody, 1993). Although it is possible that knowledge or capabilities can be traded in a single transaction, the prize is often too high, or it will still lack crucial know-how and information that is essential to appropriate value from it (Mody, 1993). Flexibility is a key concept in the learning argument as it does not have a very specific or definite end goal, in comparison to financially bound collaborations such as M&A’s that require more

information about the success of the project before a deal is struck (Mody, 1993). Instead, it is a way to collaborate with an open mind and without promises to utilize whatever possible positive effects might result – if they appear at all (Mody, 1993).

More recent work has built on the learning argument as a natural successor in the new knowledge-based economy that highlights non-market mechanisms as perhaps more important for knowledge generation in the forms of networks and alliances (Rudny, 2016). Rudny (2016) describes the distinction between knowledge acquisition and knowledge creation as two different pathways a knowledge-seeking firm can take when entering an alliance. Either learning from or learning within an alliance (Rudny, 2016).

In order for knowledge acquisition to be successful, the concept of absorptive capacity is key (Cohen & Levinthal, 1990). Absorptive capacity concerns how well a firm that acquires knowledge externally can assimilate it and ‘absorb’ it into their organizational learning (Cohen & Levinthal, 1990). A firm’s level of absorptive capacity plays a significant role in the decision to enter alliances, according to Cohen and Levinthal (1990). A study by Hagedoorn and Schakenraad (1994) that compared European, U.S. and Japanese strategic technological alliances found differences in their inclined orientations when entering an alliance. European firms were found to be more ‘absorptive-oriented’, in other words, inclined to enter alliances to share and absorb knowledge, in comparison to Japanese firms that were more inclined to have ‘generative’ linkages, i.e. knowledge generation (Hagedoorn & Schakenraad, 1994).

The business and competitive strategy view, on the other hand, states that to seek a strategic alliance could be part of a company's competitive strategy and a way to achieve their strategic goals (Hoffmann & Schlosser, 2001). Todeva and Knoke (2005) similarly suggest that to engage in a strategic alliance does not come as a responsive action; rather it is a strategic intent from firms to eventually be able to enhance their future position on the market and their outcomes. It could also be seen as a way for companies to reap the benefits of the partner firm's brand, including brand name and brand management capability, as firm value will be greater due to the result of a strong brand (Newmeyer, 2011). A firm could also engage in collaboration to utilize a

partners distribution channel (Agarwal & Singh, 2014). Channel relationships can lead to cost reductions and improvements in lead-time (Agarwal & Singh, 2014).

2.4 Risks and challenges of strategic alliances and partnerships

Strategic alliances are, despite its advantages, not entirely uncomplicated as there are several risks and uncertainties involved that companies need to consider. O'Doherty (1990) formulated it as: “Strategic partnerships and alliances perhaps represent the greatest need, but also the greatest challenge” (p.303). Mody (1993) views the choice to enter an alliance as a trade-off between possibilities for learning versus the risk that the partner acts only in self-interest. Hoffmann and Schlosser (2001) explain that inter-organizational learning will be very much limited if information between the partners is restricted. Furthermore, even though one part of the alliance sees it as an opportunity to gain new capabilities and technologies, the other party could see it as a danger to the company's competitiveness, i.e. an unwanted drain of knowledge and expertise to the partner (Hoffmann & Schlosser, 2001).

A lack of trust between the parties in a strategic alliance might also lead to opportunistic behavior from one of the firms, that might exploit the other firm's expertise (Hoffmann & Schlosser, 2001). Leakages of unplanned knowledge in an R&D alliance are greater the more complex the alliance is, such as when they are also involved in a variety of marketing and manufacturing activities (Lioukas & Reuer, 2020). This is because it drives partnering firms to gain more sources of contact, which could bring about a higher risk of knowledge leakage (Lioukas & Reuer, 2020). Firms need to be aware that engaging in a strategic alliance would require them to share the knowledge that is highly valuable during the R&D phase and that could be at risk of being appropriated by the partner firm (Oxley & Sampson, 2004). Slowinski, Hummel & Kumpf (2006) points out that as R&D alliances grow in popularity, so does the sharing of intellectual property rights in these collaborations.

Biotechnology companies are embedded in a high-risk, high-capital industry that typically owns intangible assets before a product launches, which is why it becomes even more critical to manage the intellectual property to safeguard rights (鄭聖群, 2008). As the cell-based meat

industry has similarly developed into a field that has a high level of intellectual property, IP⁴ rights become a risk factor considered for strategic partnership entry (Stephens, Sexton & Driessen, 2019). According to Mets, Talpsep and Varblane (2007), this is particularly relevant for spin-off biotech companies, as they could lack the financial and human resources to protect their intellectual property properly. In that case, patents could preferably be filed only for innovations that have a high likelihood to both be adequately protected by a patent, and that has favorable odds for market success to guarantee a financial return on the IP investment (Mets et al. 2007). Other innovations could be protected as a trade secret or early announcement strategies in order to keep costs low (Mets et al. 2007). The optimal intellectual property management strategy will, however, be firm-specific. It could in part depend on the prerequisites that the home country has for the innovation landscape and business conditions as well as the conditions that prevail in the selected target markets (Mets et al. 2007).

Risk management in R&D alliances

To counteract this uncertainty, Gulati (1995) stated that firms could adopt an equity-based governance structure to avoid the risk of knowledge exploitation within R&D alliances, thereby mitigating the risks of R&D alliances by changing and adopting a different governance structure. Teng (2007) suggests there is a need for firms to adopt a managerial framework for intellectual property control in order to protect ownership of their know-how. To manage intellectual property requires just negotiations of agreements that do not disclose trade secrets and agree to joint development (Mehlman, Uribe-Saucedo, Taylor, Slowinski, Carreras & Arena, 2010). Mehlman et al. (2010) further point out that the timing of intellectual property negotiations with external parties in the R&D phase can be critical, as the right timing could give the innovators more leverage if the technology is more developed upon demonstration. Intellectual property management requires a financial model that benefits as well as burdens the innovating firm and the external partner to an equal extent (Mehlman et al. 2010). There is also a need for the innovating firm to set an internal strategy of what will be disclosed with the partner and what information should remain for internal use (Slowinski et al. 2006).

⁴ Abbreviation for intellectual property, henceforth used

2.5 Key take-aways from the literature review

- The evolution of the cell-based meat industry adheres to both the biotechnology and biomedicine fields in terms of its research origin but has also evolved into a high-tech start-up scene within food technology currently working in the R&D phase.
- Strategic alliances and partnerships conducted in the R&D phase could be critical to the process and help get to market quicker.
- The main benefits of strategic alliances are knowledge creation and sharing, access to resources, capital and new distribution channels. They allow firms to cope better with external business environments and are important for firms in order to gain and maintain a competitive advantage. They can also aid in overcoming legal-political barriers.
- Strategic alliances are further beneficial for firms in high-tech industries to manage rapid increases in product development and fast-changing technological environments.
- Cell-based meat companies could be motivated to enter into strategic alliances by the resource-based view, transaction cost theory, learning argument or business and competitive view.
- The inherent risks of entering a strategic alliance or partnership in the R&D phase concerns intellectual property rights and the fear of innovation appropriation by the partner firm. This risk presents a challenge for firms to decide on the trade-off between access and absorption of resources and knowledge on the one hand, and loss of competitive advantage and IP rights on the other hand.

3. Methodology and Research Design

The research was conducted through a multiple-case study of the cell-based meat industry. This multiple-case study is an embedded one, which entails multiple units of analysis within each case (Al Qu'ran, 2010). A qualitative research strategy was chosen to understand a contextual setting and the company's perception of the importance of strategic partnerships and alliances in an early R&D phase (Bryman & Bell, 2011). As each company faces different prerequisites; in their technology, organizational set-up and geographical location, the use of a qualitative approach is believed to be better able to account for these different nuances (Al Qu'ran, 2010). It was assumed that interviews would give a more in-depth understanding that elaborated on their decisions and motivations.

A common critique of qualitative research is that it is too subjective (Bryman & Bell, 2011). However, it is believed that it was necessary to receive the subjective opinion in this research question to gather an understanding of how strategic partnerships and alliances could unfold. One could argue that the decision to enter a strategic collaboration is always a subjective one to the firm; thus it would not be possible to find a universal formula for the optimal partnership. The inductive reasoning approach is used, which puts emphasis on the research object and builds on theory with the new emergent information (Bryman & Bell, 2011). An inductive approach is more applicable to a qualitative method and is further motivated as the data collected in this thesis was done in parallel with theoretical reasoning in the literature review (Bryman & Bell, 2011).

A case study, in general, involves multiple methods of data gathering, in this case, to retrieve secondary data as well as to conduct interviews as data was sought to answer both a 'what' and 'how' question (Al Qu'ran, 2010). According to Greener (2008), a case study is appropriate for these kinds of problematization formulations. A multiple-case study was chosen to counteract the limitations of a single case study, that is, to draw conclusions based on only one case. A multiple-case study with three dimensions allows one to not only analyze the situation within the separate company but to compare the findings in a cross-case analysis (Al Qu'ran, 2010). The thesis is conducted within an international business context, which motivates the use of a multiple-case study to uncover better the complexities embedded within this context compared to

a domestic one (Al Qu’ran, 2010). A case study allowed investigation of the phenomena by understanding the process and the decision-making from the companies’ view (Al Qu’ran, 2010).

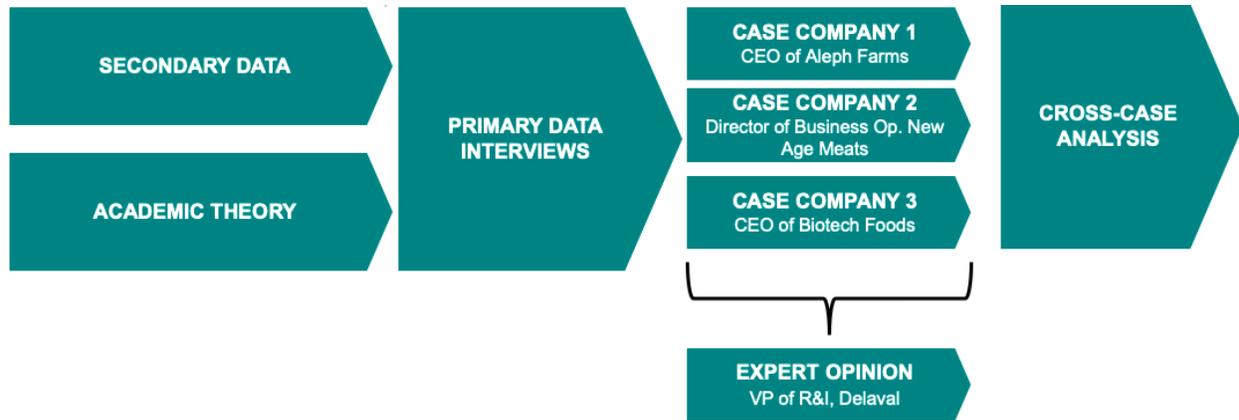


Figure 1: Method model

3.1 Data collection

3.1.1 Primary data: Interviews with case companies

In terms of sample size, there are approximately 34 start-ups today involved within the cell-based meat field. Purposive sampling was used for the gathering of interview participants, which is commonly used in qualitative research such as case studies where the population is quite small (Bryman & Bell, 2011). It was deemed fit for use, given the chosen research strategy. An interview inquiry was sent out to all companies that innovate within the cell-based meat field. This was done in order to seek participation from everyone objectively and not skew the data by selecting certain companies over others. Secondly, interview inquiries were sent out to a large sample of companies as it was expected that not many would be able to participate in such an interview. This was assumed due to practical issues and time constraints. The apparent flaw of the chosen sample method is that it is primarily based on chance and may not accurately reflect the entirety of the population.

The sample size of three cell-based meat companies for this thesis may seem small; however, given the population size, it represents almost 9 % of the industry. It should be noted that the data is not representative of the entire industry, as a case study highlights unique situations

within a given company context. Which challenges and views that are firm-specific in contrast to generalizable on an industry-level can be hard to assess; hence the findings are instead a generalization of the main characteristics that the given sample has provided. Furthermore, an expert interview with Tim Nicolaï, the Vice President of Research & Innovation at DeLaval, was conducted in order to partly reduce participation bias of the cell-based meat interviewees, and to benchmark development of cell-based alternatives in the dairy industry. It is believed this external perspective is a valuable addition to the primary data. However, it should be noted that he was interviewed in a private capacity and this is not a case in itself nor a representation of DeLaval's views on the matter. Before joining DeLaval, he worked 15 years in the meat industry but is today a Non-Executive Director in companies that deal with meat production, vegetable products and biogas production.

Semi-structured interviews were conducted. This was chosen in part as the cell-based meat industry is new; thus, the interviewer does not encompass the full understanding of it. A structured interview type would furthermore have risked losing out on details that only the interviewee knows (Al Qu'ran, 2010). A semi-structured interview format was used as it was intended to understand the companies' point of view. The open-ended questions allow the interviewee to express themselves freely and build on arguments or explanations that were outside the scope of the interview guide (Al Qu'ran, 2010). The interviews were conducted in English.

Desktop research was conducted on the companies as interview preparation in order to spot where there was a lack of information given the data that was already available. An interview topic guide⁵ was constructed with general questions that were asked to all participants, to avoid tailoring the questions to each participant, and thus be given data that did not provide clarity to the overarching research question. There were, however, variations in follow-up questions given their provided answers, since a semi-structured interview format was used. This was to allow for flexibility, which is a critical element in semi-structured interviews (Bryman & Bell, 2011). The questions were quite broad as to establish a general view of the industry.

⁵ Enclosed in Appendix A

3.1.2 Interview overview

Name	Position	Interview	Founding year	Interview date and time
Didier Toubia	CEO of Aleph Farms (Israel)	Case company	2017	06.04.20, 12:15, 24 min
Derin Alemli	Director of Business Operations at New Age Meats (USA)	Case company	2017	07.04.20, 17:45, 25 min
Tim Nicolai	Senior Vice President, Research & Innovation at DeLaval (Sweden)	Expert opinion	1878	15.04.20, 10:00, 41min
Iñigo Charola	CEO of Biotech Foods (Spain)	Case company	2017	15.04.20, 15:15, 30 min

Table 1: List of Interviewees

- Aleph Farms is an Israeli firm that was founded together with the Kitchen Hub, a food tech incubator, and Professor Levenberg at the Technion Institute of Technology. They produce cultivated meat in the form of steaks that are free from GMOs and antibiotics (Aleph Farms, n.d.).
- New Age Meats is an American start-up that develops cultured pork sausages using automation and data science. They were originally part of IndioBio’s accelerator program but divided into their own start-up in 2018 (Devenyns, 2020). Since then, they have in three stages gathered funding of US \$5.7m, and their leading investor is the tech-focused firm ff Venture Capital (Devenyns, 2020).
- DeLaval is a world-leading firm within dairy production solutions, part of the TetraLaval Group, that supplies equipment and systems to dairy farmers (DeLaval, n.d).
- Biotech Foods is a Spanish firm that through their brand Ethicameat aims to sell cultured meat to food processors. They are funded by the Center for the Development of Industrial Technology, part of the Ministry of Economy, Industry and Competitiveness of Spain (Biotech Foods, n.d.).

3.1.3 Secondary data

An abundant amount of secondary data about the industry was collected in addition to the primary data as it provides certain advantages. First of all, given the time frame and the smaller population size, it was ruled out that not each company could participate in an interview. The secondary data was motivated to receive a more well-rounded result given that this thesis attempts to gather an understanding of the industry as a whole. It was also a necessary complement to address the questions and concerns that left gaps in the interviews, as the time frame was rather short due to limited time on the interviewee's behalf. Secondary data was overall used to receive a contextual framework for the industry. It is key to provide a contextual understanding when using qualitative data analysis in order to grasp the phenomena fully. Otherwise, the findings could be interpreted in a non-related way (Dey, 1993).

Despite the above justification, it ought to be stressed that there are several drawbacks with the use of secondary data. The author behind the secondary data most likely had another objective in mind when collecting their data (Dey, 1993). Thus, there might be faults made when data was retrieved from a given context and put it into another framework with a different approach and objective (Dey, 1993). Other disadvantages include difficulties to assess the data quality and coverage as well as measurement validity, again given the different context and purpose (Dey, 1993).

3.2 Method for data analysis

It follows that qualitative data analysis will be conducted, as the data collection was gathered in a qualitative manner (Bryman & Bell, 2011). A thematic analysis was applied with the same themes used throughout the thesis to better connect the research dimensions to theories and data in the different chapters of the thesis. Each theme has certain characteristics attached to it, which enable the categorization of the data. Classifying is a key concept in qualitative data analysis to be able to describe the findings purposefully. It provides clarity and the possibility to synthesize results or make comparisons between the categories (Dey, 1993).

In terms of R1, different challenges are classified into different categories. These categories emerged as a pattern when data was gathered. The different categories could motivate different forms of partnerships and decide with whom to partner with. For R2, it then follows to categorize the types of partnerships further to investigate if they correspond to different challenge categories.

R1: What are the challenges that cell-based meat companies face during their R&D phase?

- Theme A: Can these challenges be clustered into different categories of challenges?
 - A1: Technical challenges
 - A2: Regulatory challenges
 - A3: Market challenges

R2: How do these challenges motivate firms to seek strategic partnerships and alliances?

- Theme B: How do the case companies view strategic partnerships and alliances?
 - B1: Strategic partnerships for technical challenges
 - B2: Strategic partnerships for regulatory challenges
 - B3: Strategic partnerships for market challenges

All interviews were transcribed before analysis, and this is crucial to maintain the accuracy of the information (Bryman & Bell, 2011). Dimensions of analysis were set out after primary and secondary data was gathered. This was done after the data collection rather than beforehand, as an inductive research approach was chosen. Therefore, the categorization emerges from the data itself and not from existing literature (Bryman & Bell, 2011).

3.3 Research quality

The two key dimensions that measure the quality of the research are validity and reliability. Validity is concerned with that the research investigates what is intended to be researched (Bryman & Bell, 2011). Reliability covers that it does so in an appropriate manner (Bryman & Bell, 2011).

Research validity

In order to assess the credibility of the research, the concept of internal validity is considered. This requires a transparent and systematic way to describe the entire research process, as has been done in this thesis that covers the process from sampling, to interview preparations to data analysis method (Bryman & Bell, 2011). The matter of criterion validity that is to what extent other research results correspond to these findings is a complicated matter to assess. This is because there is not very extensive research done on the topic. It then follows to instead put more emphasis on external validity, which is if the findings can be applied and interpreted in a similar case (Bryman & Bell, 2011). It shall be highlighted that a qualitative research strategy is often criticized for failing to accurately generalize findings as well as the difficulties in replicating the study to find similar results (Bryman & Bell, 2011). A multi-case study was chosen in part to see that the conclusions correlated over multiple cases and were not just an exception, an approach that strengthens external validity (Bryman & Bell, 2011). It is then reasonable to believe that similar results can be drawn if another case in the same industry was investigated, however, the level of generalizability is for the individual reader to assess (Bryman & Bell, 2011).

Qualitative research is considered a process, and since the business landscape evolves, this research gives a snapshot of the situation now but does not guarantee identical findings if the research was conducted at a later stage. The pragmatic validity of this thesis, if the findings and the knowledge that emerged are of use (Bryman & Bell, 2011), are deemed high. This owes to the business-oriented objective and approach and is especially true since the industry is in its nascency and the research field is not as extensive compared to other industries.

Research reliability

Reliability is a key concept for business research and concerns the level of dependency one can assume the research has (Bryman & Bell, 2011). The problematic aspect of studying the view of industry participants is that it may affect participation bias and in turn, the objectivity of the results. The interviewees may be inclined to present their industry in what appears to be a more positive light. One attempt to combat this was that questions were not sent out before the interviews to encourage genuine and spontaneous answers rather than well thought through replies that could have been angled at whatever the interviewee believed would be the ‘correct’

response. An expert opinion from outside the industry was included to nuance the findings and strengthen reliability. A second possible flaw to consider is the possibility of participant error due to an unwillingness to share confidential information. It is possible certain aspects were not shared as the interviewee was not able to disclose details about, for example, partnerships.

4. An industry outline

4.1 The cell-based meat industry

Most start-ups and companies within the cell-based meat field are currently in the prototype phase (Froggatt & Wellesley, 2019). The product span is broad but mainly centers on alternatives to replace animal protein that range from meat to dairy and eggs. There are companies that work with both plant-based methods as well as cellular processing, such as JUST Inc (James, 2019). However, the number of companies that have cell-based meat as their core product, which is the focus in this thesis, is around 34 (Cell-Based Tech, n.d.).

The United States, Netherlands and Israel are at the forefront with the highest concentration of companies. However, start-ups from Canada, China, Japan, Spain, Turkey, Argentina, UK and Russia are also working on prototypes (Cell-Based Tech, n.d.). Yaakov Nahimas, founder of Future Meat Technologies, explains since the cost of salaries are lower in Europe and Israel compared to Silicon Valley, cell-based meat start-ups in Europe and Israel have an advantage (Knowles, 2019). Memphis Meats, CUBIQ Foods and Mosa Meat, the most funded companies within the field, estimate that their products will be available for a premium segment by 2021 (GFI, 2019). Biotech Foods shares in an interview that their products will be ready for market by 2021 as well, but at a price comparable to traditional meat products (Rodriguez-Fernandez, 2020).

4.2 The rationale for cell-based meat

The field has positioned itself as a transformative and innovative solution that can accelerate the shift to meat alternatives that are more sustainable, healthier and safer. Cell-based meat has the potential to combat the health-damaging effects of red meat as well as food safety concerns. The World Cancer Research Fund (2018) has stated that high consumption of red meat is associated with a heightened risk for various types of cancer. In terms of the nutrients and composition of cell-based meat, there is an opportunity to alter the components that are less healthy to become more nutritious to combat the health-damaging effects of meat (Froggatt & Wellesley, 2019).

Since cell-based meat can be produced without the need for animals, it reduced the need for antibiotics that are otherwise used to ensure animal health (Froggatt & Wellesley, 2019). The meat industry's use of antibiotics has been questioned as of late, but animal diseases such as the African Swine Pandemic that has threatened the global pig industry points to how dependent the industry still is on antibiotics to fight diseases (Sánchez-Cordón, Montoya, Reist, Dixon, 2018). As for the food safety aspect, the risk for contamination is much lower than for regular meat, which is partly owed to the production process that can be strictly controlled (Froggatt & Wellesley, 2019).

The main argument for the production of cell-based meat is that it is better from an environmental standpoint. The meat industry is far from sustainable as livestock production accounts for 80% of total agricultural land use (Wirsenius, Azar & Berndes, 2010), which is equal to 30% of all land surface area (Penn, 2018). Livestock supply chains amount to 14.5% of total greenhouse gases (FAO, 2020). According to Djekic (2015), the chain of the meat industry has three main environmental impacts; environmental pollution, climate change and consumption of natural resources. It is these three pillars that cell-based meat innovations could resolve as greenhouse gas emission would be significantly lower, and no animals would be harmed, while still offering a similar product to the end consumer (Mancini & Antonioli, 2019). Furthermore, the production of cell-based meat would be more resource-efficient, in terms of land, water and energy use (Kadim, Mahgoub, Baqir, Faye & Purchas, 2015). Industrial factory farming could also be argued to pose ethical dilemmas in terms of animal welfare (Pluhar, 2010).

4.3 The competitive landscape

It is important to stress that the industry is in a very early phase, and that cell-based meat companies do not pose a real threat as a competitor to the meat industry yet (Kateman, 2020). The meat consumption worldwide is projected to be 45.3 kg per year per capita in 2030, an increase from 36.4 kg per year per capita in 1999 (WHO, n.d). Estimates vary, but the highest estimate approximates that the global meat market industry was valued at USD 1.8 trillion in late 2019 (Alvarez & Kindred, 2019). Thus, it is not an insignificant challenge to attempt to disrupt the industry as a whole.

It is worth mentioning that new plant-based meat alternatives⁶ have been on the rise for quite some time now, and are fighting for a share of the meat market (Alvarez & Kindred, 2019). Companies such as Beyond Meat, which went public last year, and Impossible Foods, planning their IPO during 2020, have received a lot of media attention (Alvarez & Kindred, 2019). The American retail market for plant-based meat alternatives was valued at USD 810 M in 2019, an increase of 10 % from 2018, but still only 2 % of the total sales of packaged meat in the U.S (Alvarez & Kindred, 2019).

The likelihood of cell-based meat to capture market share from the meat industry once commercialized, should not be ruled out though. Europe is the dominant market for meat substitutes, with the United Kingdom at the forefront (Mordor Intelligence, 2018). Asia is, however, the market with the highest growing demand for meat substitutes and is therefore expected to drive the market going forward (Mordor Intelligence, 2018). A public consultation carried out by the EU in its member states showed that over 74 % of the respondents were open to considering a change of diet as to opt for more sustainable choices (Froggatt & Wellesley, 2019).

The potential for plant-based meat and cell-based meat alternatives to supply the sought-after shift for sustainable options is said to be greater than prior vegetarian meat substitutes (Froggatt & Wellesley, 2019). This is due to that plant-based meat alternatives try to imitate the experience of real meat in terms of taste and texture (Alvarez & Kindred, 2019). This aspect is even more applicable to cell-based meat products that are biologically equivalent to real meat, which follows that their target group are meat consumers (Froggatt & Wellesley, 2019).

⁶ Not to be confused with vegetarian or vegan food products such as tofu

5. Understanding the industry challenges

This section commences the thematic analysis and presents secondary data according to the research dimensions. The challenges the industry currently faces have been divided into three areas: technical, regulatory and market. The technical challenges represent the issues a start-up faces in the upstream development of the product, that is, related to R&D, production and technology development. The regulatory challenges are the legal barriers such as legislations, food certificates and labelling laws that firms have to take into consideration being food producers. The market challenges are the downstream aspects that are important once the product is to commercialize, such as distribution, marketing and consumer behavior.

5.1 Technical challenges to produce cell-based meat

In order for cell-based meat to successfully enter the market, the production must scale up to a level of industrial production (Kateman, 2020). Large scale production of cell-cultured organisms is rare but do exist to some extent within medicine and microbial technology, which gives hope that scaling is possible for this industry as well (Kadim et al. 2015). Therefore, the technical challenges of product development are a crucial area for cell-based meat companies to solve.

One technical area in need of progress is the availability of the right cell resources (Guoqiang et al. 2020). There is a need to secure enough similar starter cells to perform the processes that enable multiplication of the same cell (Guoqiang et al. 2020). Advancements have been made in the last couple of years that have allowed for the identification of several stem cell types and cell sources that can be used in the growth of tissue. Thus, research is currently conducted to find new cell sources (Guoqiang et al. 2020). In order for the cells to grow, media is needed to supply the cell with the appropriate nutrients and the right environment conditions (Guoqiang et al. 2020; Merck Group, 2020). Thomas Herget, Head Innovation Hub at Merck Group that supplies cell lines, explained in an interview that the major cost driver is cell culture media which stands for 50% to 80% of costs (Merck Group, 2020). Further stating, cell-cultured media involves a lot of know-how and research (Merck Group, 2020). Therefore, it is challenging for a start-up company to develop it on their own (Merck Group, 2020).

A nutrient serum has commonly been used in the process but runs the risk of contaminating the cell with viruses (Kadim et al. 2015). Because of that, several other serum-free mediums are in development, however, they have not proven cost-effective enough (Kadim et al. 2015). Another aspect is that the original serums used in the process are not animal-free, which has raised criticism from an ethical point of view (Kadim et al. 2015).

One of the main factors that hinder the industry's ability to scale large enough to compete with traditional agriculture is the lack of appropriately sized bioreactors (Guoqiang et al. 2020). The cells are placed in a bioreactor in order to grow new cell tissue (Mattick, 2018). Biotechnology products that use bioreactors today are commonly produced in a low volume to a high price (Guoqiang et al. 2020). Hence the bioreactors needed for large scale production of cell-based meat have to be custom-built, which increases production costs (Guoqiang et al. 2020).

Another issue that will have implications for future market acceptance is cell-based meat's resemblance to traditional meat (Guoqiang et al. 2020). There is currently not a cost-efficient or resource-efficient way to re-create the quality components of regular meat in cell-based meat (Guoqiang et al. 2020). In summary, the main technical challenges the industry needs to solve to enable large scale production and economies of scale is to optimize: "tissue engineering, better culture conditions, large-scale bioreactors and the development of cost-effective and safe serum-free culture media" (Guoqiang et al. 2020, p. 450).

In the case the company chooses to conduct a substantial part of the process in house, there is the matter to safeguard intellectual property on its technologies (Watson, 2020). Intellectual property rights, such as patents for the technology, could ensure a competitive advantage as well as to send a signal to investors (Watson, 2020). The CEO of Meatable, Krijn de Nood, stated in an interview that investors value defensibility and the company has IP on a variety of components in the technical process and a granted patent (Watson, 2020).

The co-founders of the cellular fish company Finless Foods, Selden and Wyrwas, further builds on de Nood's argument that intellectual property rights are of importance as to stand out when

seeking investments funds (Watson, 2020). Finless Foods claims its unique angle is their attempt to create a cell-based alternative to Bluefin tuna, a species that is under threat of extinction (Watson, 2020). Bluefin tuna further has a premium price point that also suggests it could be interesting to find an alternative to, which Finless Foods further hopes can attract investors (Watson, 2020). There are however, other hurdles with ensuring intellectual property rights that leave innovators at a tradeoff. CEO of New Age Meats, Brian Spears, reflects on that the high expense that a patent requires is not a priority at the moment, as the start-ups are first and foremostly working hard to drive down costs (Watson, 2020). Spears furthermore points out that despite that patents can attract investors, it does not entail that the patents are particularly valuable (Watson, 2020).

5.2 Regulatory and legislative challenges

Regulatory frameworks are in place to most notably ensure consumer safety of products (Froggatt & Wellesley, 2019). They have to keep improving and expand to accommodate technical improvements and new product development (Froggatt & Wellesley, 2019). A lack of regulations will evidently prove a challenge but implemented yet harsh regulations could also discourage new cell-based meat products from ever commercializing (Froggatt & Wellesley, 2019). Thus, the support from regulators is crucial to accelerate the industry's path to market (Froggatt & Wellesley, 2019). Many countries currently work to accommodate cell-based meat within regulatory frameworks (Food Standards of Australia and New Zealand, 2019; Neo, 2020; SFA, 2019). However, most cell-based meat companies operate within the U.S. and EU region, which motivates the focus on these regions below.

Regulatory situation in the United States

There were no regulatory frameworks in place to address cell-based meat in the United States before 2019 (Penn, 2018). The Federal Drug Administration (FDA) and the United States Department of Agriculture (USDA) had difficulties in categorizing cell-based meat as it was defined as food but did not suffice to any of the definitions of the food subcategories (Penn, 2018). As cell-based meat is not an ingredient but an end product in itself, it could not fall under

already established regulations for categories such as food additives (Penn, 2018). Further, it could not be sorted under regulations for GMOs, as they seek out potential plant pests that would not include cell-based meat (Penn, 2018). Therefore, it was evident that current regulatory frameworks in place were not equipped to deal with cell-based meat.

On March the 7th 2019 the U.S. Department of Health and Human Services (HHS), FDA, USDA, Food Safety and Inspection Services (FSIS) released a formal agreement between the different parties that would manage the legal process of cell-based meat (USDA, 2019). A joint regulatory framework was brought forward, where the FDA oversees the various stages of cell collection and growth, whereas the FSIS will manage the production of cell-based meat (USDA, 2019). This joint regulatory framework was brought forward to ensure the safety of cell-based meat for eventual consumption (USDA, 2019). The CEO of Aleph Farms stated in an interview that the company welcomes collaboration with the USDA and FDA in an attempt to ensure the cell-based meat products will be safe and properly labelled (Pellman-Rowland, 2019).

An overarching hurdle cell-based meat companies in all countries still have to tackle is how to label their products. The labelling of cell-based meat products has been a major source of conflict between the cell-based meat companies and conventional meat producers. It is exemplified by the National Cattlemen's Beef Association decision to put “fake meat” labelling bills as a top priority in their 2019 policy proposals (National Cattlemen’s Beef Association, 2019). The regulatory framework put forward by the FDA and USDA did not provide federal regulation of how to label cell-based meat products (Pitz, 2020). Therefore several U.S. states have now proposed labelling restrictions for the industry (Pitz, 2020). This hinders cell-based meat companies to accurately label and market their products towards meat consumers, which is problematic as this is their primary target group (Pitz, 2020). According to Watson (2019), 25 U.S. states have proposed bills that would prohibit cell-based meat products from being labelled as “meat” or “beef”, and in eight of these states the bill has already passed. Advocates argue that labelling cell-based meat as “meat” is misleading, false, and a deceptive label (Pitz, 2020).

The Good Food Institute⁷ is currently lobbying to prevent these bills from passing and has challenged a labelling bill in Missouri (Watson, 2019), where the court ruled in their favor (Pitz, 2020). In an interview (Watson, 2019) Michele Simon, executive director at Plant-Based Foods Association, stated that the priority is to ensure the bills do not pass. Simons argues that the bills are a way for states to hinder the development of cell-based meat and give the conventional meat industry further market advantages (Watson, 2019).

Labelling could further influence consumer acceptance (Turner, 2019), which is why regulators' decisions could act in favor of either the conventional meat industry or the cell-based meat industry. Danielle Beck at National Cattlemen's Beef Association stated that they do not want the cell-based meat products to overtake conventional meat's position on the market and therefore want a fair playing field (Poinski, 2020). Scott Wheaters at the Good Food Institute shared in an interview that the outcome of the proposed labelling bills made by the states will have a significant difference in the long run (Poinski, 2020). Wheaters further suggest this will hinder cell-based meat products from commercializing, and even so, they may face different labelling schemes and regulations in all states, which would prove very costly (Poinski, 2020).

Regulatory situation in the European Union

Developments on the regulatory side within the EU have progressed to include these new innovations. The EU Commissions' regulation from 2015 categorizes cell-based products as novel foods (European Commission, 2019). Further, it states that the new technology will have to go through pre-market authorization in order to provide full transparency to consumers (European Commission, 2019). Even though the EU could endorse cell-based meat could, it could still face inspection, regulations and requirements of alternative sorts by the separate member states (Foote, 2020). European cell-based meat producers could, therefore, be forced to face both pre-market authorizations by the EU as well as comply with the national legislation of the member state it wishes to enter the market of (Foote, 2020). This could complicate cell-based meat companies' market entry in individual EU member states.

⁷ U.S. non-profit organization acting in favor of plant-based and clean meat, see further explanation under 6.3

According to Kurrer and Lawrie (2018), the EU is positive towards the significantly reduced environmental impact that cell-based meat would potentially present. A reduction in livestock production within the EU could contribute to the EU 2030 goal of a 40 % reduction in greenhouse gas emissions (Kurrer & Lawrie, 2018). The EU encourages policymakers in its member states to pursue support of the development and production of cell-based meat (Kurrer & Lawrie, 2018). Each member state is encouraged to get involved in the technical development of cell-based meat to help transition the food industry into a more sustainable one (Kurrer & Lawrie, 2018).

Policymakers in the member states of the EU are further encouraged to help educate the consumers about cell-based meat and convey transparency (Kurrer & Lawrie, 2018). The EU has expressed concern though of the impact that cell-based meat could potentially have on the livestock sector (Kurrer & Lawrie, 2018). The livestock sector makes up 45% of the total agricultural sector within the EU and employs almost 30 million people (ATF, 2017). The livestock sector thereby has a considerable impact on the European economy (ATF, 2017). If cell-based meat were to compete in the market successfully, it could have an impact, not only on an individual level but on entire regions that are highly dependent on livestock for their economic welfare (Kurrer & Lawrie, 2018). EU member states are therefore encouraged to examine how the farming sector could be diversified, and, if possible, support the transition for farmers to leave livestock production in favor of crop production (Kurrer & Lawrie, 2018).

Similarly, to the US, the EU faces difficulties with the labelling of cell-based meat (Merten-Lents, 2018). According to the EU FIC regulation⁸, the product name of cell-based meat must convey clear, precise and fair information to the consumers (Merten-Lents, 2018). According to Merten-Lents (2018), it is very likely that the product name has to disclose that the meat is lab-grown. Clarification on this matter will follow when the first company starts the process to undergo the regulatory framework (Merten-Lents, 2018).

⁸ Regulation on Food Information to Consumers

5.3 Market challenges

Cell-based meat faces a variety of challenges, but consumer acceptance could prove the most significant hurdle to overcome (Sharma, Thind & Kaur, 2015; Siegrist, Sütterlin & Hartmann, 2018). In a systematic review of consumer acceptance of cell-based meat, Bryant and Barnett (2018) found that a majority of consumers would be willing to try cell-based meat. On the other hand, it was only a minority of consumers who would choose it over traditional meat products or alternatives. This concern is explained by consumers' lack of understanding for the new technology and unfamiliarity of the product (Bryant & Barnett, 2018). Many consumers are also hesitant toward the safety and perceived unnaturalness of the product, and the price point (Bryant & Barnett, 2018).

In a later study, Bryant and Barnett (2019) found that consumer attitudes are to some extent also dependent on how cell-based meat products are labelled and framed. In order to increase consumer acceptance of cell-based meat, it is essential to inform the consumers about the final product in a non-technical way, hence, to not emphasize the production method (Siegrist et al. 2018). However, Bryant and Barnett (2018) believe consumer acceptance will presumably rise with increased regulation, familiarity, commercial availability and media coverage, which would promote the production of cell-based meat.

6. Current status: strategic partnerships and alliances today

6.1 Investment grade

Investments are crucial for the survival of cell-based meat start-ups as they lack revenue streams in the R&D phase (Stephens, Sexton & Driessen, 2019). The investment interest in the area is deemed to be high. According to Alvarez & Kindred (2019), the larger undefined field of “food-tech” received a total investment of USD 5.4 billion in the first two quarters of 2019. Food producers in general have shown increased interest, meat producers in particular, to invest in meat-alternative innovations (Alvarez & Kindred, 2019). The attraction is believed to be centered mainly around the possibility to be able to patent innovations, which are quite unusual within the food industry, but which represents a highly competitive advantage (Alvarez & Kindred, 2019).

According to GFI’s *State of the Industry Report 2019*, there was a total investment of USD 73.3M in the cell-based meat industry last year (GFI, 2019). In 2018 that total accounted for USD 49.4M, and there was an increase in capital investments with + 169 % between 2017 and 2018⁹ (GFI, 2019). In terms of publicly disclosed investments, 70 different investors have contributed to funds (GFI, 2019).

The profile of the most active investors can be primarily categorized into impact investors, venture capitalists, multinational meat companies and accelerators or start-up incubators (GFI, 2019). Impact investors set out to invest in innovations that contribute to a more sustainable society to some capacity. Nearly all impact investors that have invested in cell-based meat are members of GlassWall Syndicate, which is a group that share the same investment vision of enabling solutions and products for a better tomorrow (GlassWall Syndicate, n.d.).

⁹ Both these sums were calculated by GFI (2019) only with the companies that primarily pursue cell-based meat, excluding companies that have other products in their portfolio

On September 6th, 2019, Agronomics Limited became the first publicly traded investment company to invest in a cell-based company¹⁰ (Sunness, 2019b). Before their USD 750 000 investment in BlueNalu, all investments to cell-based meat start-ups had been funded by private investment firms, mostly venture capitalists (Sunness, 2019b). China, Singapore, Japan and the Netherlands are reportedly the only governments that have funded research or invested in cell-based meat (Stephens, Sexton & Driessen, 2019). For New Harvest, as a research institute focused on cell-based meat, their goal is to obtain government funds in the United States as well. (Synbio Markets, 2019).

6.2 Partnerships for technical challenges

Given the immense technical challenges that cell-based meat companies face and the limited resources a smaller start-up team traditionally has, partnerships are perhaps not optional but necessary (GFI, 2019). This leaves them at a strategic crossroad that entails to which degree the company chooses to develop vertical integration and to work with the entire process in-house, or to outsource elements to suppliers. Brian Spears, CEO of New Age Meats, shares in an interview that he is sceptical of some cell-based meat companies' decision not to seek external supplier expertise (Watson, 2018). Stating there are players on the market that if integrated early, could be of great benefit and provide solutions to the cell-based meat companies (Watson, 2018).

Partnership opportunities in the technical process can roughly be divided into four categories: cell line development, cell culture media, scaffolding and bioreactors (GFI, 2019). Another aspect of partnerships that have played an important part in establishing the cell-based meat industry is intra-industry knowledge sharing (Stephens, Sexton & Driessen, 2019). The cell-based meat community started to form back in 2008 with a series of university symposiums and conferences (Stephens, Sexton & Driessen, 2019). These gatherings were aimed to share experiences and brainstorm solutions to technical challenges and how to advance the R&D phase (Stephens, Sexton & Driessen, 2019). Representatives from the field also made appearances at large scientific conferences to increase awareness and the academic legitimacy of the field to a larger scientific community (Stephens, Sexton & Driessen, 2019). Today, the Industrializing

¹⁰ Today there are 32 publicly traded companies that either produce inputs needed in the production process or have invested in cell-based meat

Cell-Based Meat Summit is the key industry event that gathers the community to solve mutual scientific and technological issues as well as to act as a networking platform for industry stakeholders (Industrializing Cell-Based Meat, 2020)

6.2.1 Partnerships with Research Organizations and Universities

Partnerships between the new industry and academia was naturally a part of the first wave of the field's development as it stems from research (Stephens, Sexton & Driessen, 2019). Many partnerships between universities and cell-based meat companies remain from original research projects, for example, Mosa Meat that was a spin-out research project at Maastricht University (Byrne, 2020). Two institutions that have played a key role in the development of the cell-based meat community is the Good Food Institute and New Harvest. New Harvest is a research institute that has funded cellular agriculture projects to a value of approximately USD 2.2 M since its founding in 2008 (New Harvest, n.d.). They currently fund 14 different projects within the field and have funded eight projects that have been finalized (New Harvest, n.d.). Amongst them worth a mention is Perfect Day Foods, which is a company that was a spin-off from New Harvest and that has launched their alternative dairy products to the market, and Mark Post's cell-based beef, that was first ever to produce a lab-grown product (New Harvest, n.d.). Kate Krueger, Research Director at New Harvest, explains that they focus on investments to support upstream R&D in the industry as they believe this is a key success factor, rather than singling out support for companies (Synbio markets, 2019).

The Good Food Institute is a nonprofit organization that works to promote, educate and support within the field of plant-based and cell-based meat products (GFI, n.d.). Their work spans across the entire value chain, which makes it impactful. They aim to support new innovators by fostering collaborations between students, entrepreneurs and scientists to match talent with new opportunities (GFI, n.d.). For companies submerged in the industry, they offer strategic support adapted after their maturity level as a company (GFI, n.d.). For new start-ups, the Good Food Institute (n.d.) helps out with marketing, design and media contact as well as to assist in business and legal matters. They also educate corporations and institutions on the R&D progress of cell-based meat and its advantages connected to sustainability and health (GFI, n.d.). Lastly, they maintain a dialogue with retailers, restaurants and foodservice providers to promote and

normalize cell-based meat products (GFI, n.d.). In February 2019, the Good Food Institute (n.d.) granted six academic research projects in six different nations to encourage further collaboration between academia and cell-based meat companies. Their contribution of USD 1M amounted to the greatest funding in cell-based meat product development in the last twenty years. In 2019, they announced the plan to launch a “Cell-based Meat Research Center” to serve as a transdisciplinary hub that connects all researchers from both the private, public and academic sector (GFI, 2019).

Tech accelerators and start-up incubators is another collaboration form that played a key part in bridging the first research wave to the second wave, where a start-up scene was established (Stephens, Sexton & Driessen, 2019). Tech accelerators typically offer a program for the start-ups that include resource-based help such as access to lab and equipment, as well as funding and networking opportunities (Stephens, Sexton & Driessen, 2019). IndioBio, a tech-accelerator specifically targeted at upscaling biotechnological solutions, has helped out the cell-based protein start-ups New Age Meats, Finless Foods and Clara Foods (Stephens, Sexton & Driessen, 2019).

6.2.2 Industry partnerships

Before 2017, partners to the industry were mainly dominated by venture capitalists, tech accelerators and individual investors (Stephens, Sexton & Driessen, 2019). Due to the close connection to the biotechnology field, a few life-science companies such as the Merck Group have also invested within the field, the latter having established clean meat as one of the top innovation fields (Merck Group, n.d.). The engineering company Black & Veatch (n.d.) has established their NextGen Agriculture platform to help scale new technologies to market, amongst them cell-based meat. They also collaborate with The Good Food Institute to leverage expertise to progress commercialization for the industry (Black & Veatch, n.d.). However, 2017 marked a shift where the interest from the meat industry and livestock production stakeholders increased significantly into protein alternatives in general, and the cell-based meat industry in particular (Stephens, Sexton & Driessen, 2019).

Stephens, Sexton and Driessen (2019) suggest that the meat industry acknowledged the emergent field as a real threat and began to correspond accordingly to stay competitive and not be disrupted. According to GFI's *State of the Industry Report*, a strategic partnership between established meat companies and cell-based meat companies could benefit both parties and allow for diversification of offerings to end consumers on the one hand, and "sharing of expertise, distribution networks and production infrastructure" on the other hand (GFI, 2019). Meat industry stakeholders that have partnered up with cell-based meat companies include, but are not limited to, Bell Food Group, Tyson Ventures, Cargills and PHW (Bell Food Group, n.d.; O'Hear, 2018; Rowland, 2020;).

VisVires New Protein, one of the partners of Aleph Farms, summarized the key benefit in partnering up with the food industry as the need to create an ecosystem for the industry in a sustainable way (Solomon, 2019). Nutreco, a partner to the cell-based meat pioneer Mosa Meat, agrees: "But that vision requires a whole value chain or ecosystem that we could never build ourselves. In the last few years, other companies are beginning to see the opportunity, and they have reached out" (Byrne, 2020). Nutreco's partnership with Mosa Meat is not limited to a funding purpose, but to collaborate on exploratory work to ensure that their future value chain has raw materials suppliers, such as for cell culture media (Byrne, 2020).

6.3 Alliances for regulatory challenges

As no product has launched to market yet, nor has a case been filed, the legal territory is still quite unknown (Byrne, 2020). It is an area that could either enable success for the industry – or stop it. As CEO of Mosa Meat, Maarten Bosch, exemplified in an interview, their market introduction in 2022 is dependent on regulatory approval (Byrne, 2020). In an attempt to get the FDA and USDA to create a regulatory framework for cell-based meat a signed letter was sent to the White House in August 2018 by the cell-based meat company Memphis Meats and the North American Meat Institute (Memphis Meats & North American Meat Institute, 2018). This could be seen as a joint effort by the two industries to try and pave the way to a regulatory framework for cell-based meat companies.

The Alliance for Meat, Poultry & Seafood Innovation, AMPS Innovation, is a successful example of an alliance formed to combat regulatory challenges (AMPS Innovation, 2019). The AMPS is a coalition of five cell-based protein companies that worked with the USDA and FDA to improve the regulatory framework put in place in March 2019 (AMPS Innovation, 2019). AMPS Innovation (2019) works closely with the regulators to create a regulatory environment for the cell-based meat industry that will benefit further innovation and development. The alliance partnered up with the PR firm Glover Park Group in early 2020 to lobby on their behalf for the USDA and FDA to adjust the regulatory framework on cellular-based products (McCauley, 2020). This could be interpreted as the industry is moving closer to the market, according to Sunness (2020).

The U.S. regulatory framework was a great leap forward for cell-based meat companies to eventually be able to sell their products on the U.S. market. However, it is still considered to be in the early stages (Sunness, 2019a). According to AMPS Innovation, there is still work to be done to advance the products to restaurants and retail stores (AMPS Innovation, 2019). AMPS Innovation also sees a potential and need for the regulatory framework to improve its accommodation for future innovation and change within the industry. They suggest that the current regulatory framework still poses challenges for the industry and aim to create a united front to have an open dialogue with the USDA and FDA (AMPS Innovation, 2019). They view close relationships with regulators as an essential step to get their products to market (Sunness, 2019a). Andrew Noyes, Head of Global Communications for JUST¹¹, agrees in an interview and explains that regulation was the greatest obstacle at the moment (Sunness, 2019a). Further stating the company is currently trying to create a pathway to market by working with regulators from different countries (Sunness, 2019a).

6.4 Collaborations for market challenges

The challenges entailed with commercialization are mostly focused on the advancement of R&D and the regulatory side. The work that needs to be addressed to go to market does not seem to constitute a separate purpose of forming partnerships of, rather it is embedded in many long-term

¹¹ JUST Inc. is an American company currently prototyping cell-based meat

partnerships today to solve once it reaches that stage. The Good Food Institute exemplifies this by following the innovators from start to finish; granting research projects and creating networking opportunities to assist with business-related concerns (GFI, 2019). There are exceptions though, especially for the companies that are closest to market such as Future Meat Technologies. They received funding in late 2019 to build their first manufacturing plant, which would enable them to produce at a competitive cost to meat (Shieber, 2019). The CEO of Future Meat Technologies emphasizes their focus on collaborations with industry partners as well as creating a network of investors for the next stage market challenges, to be able to pave the way to market (Shieber, 2019). Future Meat Technologies names Tyson Ventures¹² as one of their most strategic investors and further reveals that their primary goal is to go to market, be it under the Tyson name or not (Shieber, 2019).

¹² Venture capital firm of meat producer Tyson Foods

7. Results and analysis - Empirical data findings from interviews

The interviews were conducted with Didier Toubia CEO of Israeli firm Aleph Farms, Iñigo Charola, CEO of Spanish firm Biotech Foods and Derin Alemlı, the Director of Business Operations at New Age Meats. Further, an expert interview was conducted with Tim Nicolăi, Vice President of Research & Innovation at DeLaval that is incorporated into the findings. His comments are made in his own name and does not necessarily reflect the views of DeLaval. The interviewees' last names will henceforth be used as references.

7.1 Theme A: Challenges

The threefold categorization that this thesis' thematic analysis takes surprisingly corresponds to Biotech Foods threefold strategy. Charola shared that their first stage is focused on technical challenges in the R&D phase, second phase concerns achieving scale and addressing regulatory challenges. The final stage is industrialization as well as commercialization. This categorization follows a chronological order of innovation evolution; from idea to market, and it is clear they need to be addressed in the same order to progress onto the next stage. Naturally, these challenges are not dealt with in silos but parallel, though with differing degrees of priority.

7.1.1 Technical challenges

The ability to produce large quantities of meat at a low cost in an efficient manner without compromising on quality is today the key challenge, and goal, for Aleph Farms. Toubia explains that they are developing a proprietary and large-scale production platform in order to achieve their goal. The platform uses non-animal inputs as they have formulated their serum-free and animal-free growth medium. Toubia describes they have developed six different technologies, and they are the only company that focuses on cultivated meat as whole pieces of meat, not minced meat. This entails that they face other challenges with their production platform and technology compared to other companies.

Similarly, Derin Alemlı explains that their greatest challenge now is "R&D and developing this process into a cost-effective system". That entails how to scale up to a level of industrial

production from a bench lab scale. A key part of their process lies in how New Age Meats focuses on data science and automation to optimize production. In contrast to other cell-based meat companies, New Age Meats sees the production as more than just an academic exercise and sees the potential for automation to solve technical challenges in the process. According to Alemli, data science will enable the company to accelerate the process forward much more efficiently and advance the products to be ready for the market. In the short-term Alemli states that the COVID-19 crisis poses a problem. Due to the pandemic, the company does not have access to their labs and is, therefore, unable to progress scientifically. Alemli assures this is more of a short-term challenge, but that the company is exploring options to deal with the situation. Going forward with its next capital raise, the company wants to expand its lab space and reactor size in an attempt to scale up production. Alemli hopes that at that stage, the company will be able to output a lot of tonnage of cell-based meat to serve a large population.

Biotech Foods has separated its plan for how to cope with challenges into three stages, wherein the first and second stage entail technical challenges. Their first stage was focused on R&D development to enable large scaling of the technology. They are now in the second phase that aims to implement industry scaling. Charola also emphasizes cost efficiency as a key element: “You need to scale and also at a very low price, so that we can be competitive against alternatives that the consumer has, like meat and plant-based”.

Some companies choose full integration and develop the technological platform by themselves, while others prefer to leverage existing know-how and technologies in order to make the whole process more proficient and quicker to go to market. To find the right balance between vertical integration and performing the elements in-house versus to partner up is a company-specific choice, says Toubia. Toubia believes there is a distinct advantage to partner up to ensure they can leverage existing know-how that is not naturally in the core competence of the firm. He points to the fact that it is hard to manage different projects that require breakthroughs with a small team and limited resources – therefore, it makes sense to enter partnerships. Regarding disadvantages, he explains that: “The downside of that is that for a cultivated meat company it is important to build its intellectual property”. The intellectual property secures a competitive advantage, and Aleph Farms believes companies that lack intellectual property will find it difficult to sustain

long-term in the market. This is because it is a new industry, and since each company tries to secure its position in the market, their approach needs to be unique and promote a competitive advantage.

Nicolaï also believes that cost efficiency is key for cell-based meat to commercialize. He explains that the technology has been around in the medical field for a long time. Therefore it is not the technology itself that stands in the way of scaling it up as the parameters are controlled in the lab, but the price. Nicolaï adds that one aspect that hinders cost-efficiency follows with the requirements that the process needs to be safe not to jeopardize the safety of the product itself. Although technological hurdles such as the safety aspects tend to be overcome, it is expensive. He explains:

The main risk is that you might need to work under very aseptic conditions because you cannot allow an infection to your base culture, which then you would be growing something you would not want to grow essentially.

Nicolaï adds that a key technical challenge lies in the company's ability, as Aleph Farms touched upon, to receive the right texture and taste of the product for it to be equivalent to meat. He explains that soy and plant-based products have in the past failed to acknowledge this aspect, but that cell-based meat can overcome the texture issue. This could then: "facilitate the cell-based meat penetration in the market", but Nicolaï also points out that that cell-based dairy alternatives have an even larger advantage in this regard. There are fewer textural issues for dairy, and they are possible to mimic with different substances. For that reason, among others, Nicolaï believes the dairy product segment will advance before cell-based meat products.

In summary, the technical challenges are the most dominant ones in the R&D phase. All three case companies claim that scaling up production in a cost-efficient way is their main focus now. Doubt does not lie in the technology itself since it has proven successful within medicine, instead it is to scale it up to industrial production that is the hurdle. An essential aspect of developing the right product, apart from food safety, is to achieve a resemblance to meat in terms of texture and taste. Lastly, intellectual property is the key consideration here that affects the company's

decision to which degree they vertically integrate in terms of how much they externalize R&D or outsource parts of the process to suppliers, and how much of the R&D they perform in-house.

7.1.2 Regulatory challenges

Cell-based meat will be a new product to the market, and Charola acknowledges that regulations are a challenge as: “in order to sell this product the market has to regulate it”. Nicolaï believes that regulatory challenges are the greatest obstacles for these new technologies. According to New Age Meats, regulatory challenges are not yet present at this moment, but if the company successfully engineers a cost-competitive product, then the legal aspect will pose an obstacle as the regulatory framework is not fully developed.

The approval process put forward by the FDA requires that the company has a relatively spelt out version of what the final product will be. Alemli states that a few of these key factors have not been defined within the company yet. He adds that no cell-based meat company has yet attempted to go through the new regulatory framework, and it is therefore unclear what is actually required of the companies. Charola says that the regulators value product safety to guarantee consumer safety. Therefore, the regulatory framework in the U.S. will demand much information to understand what kind of effect this product will have. Charola suggests:

But this is the first time they are going to regulate it, so they are going to ask for a lot of information in order to make sure that this is safe. And will probably lead to delays on regulation...

According to Nicolaï “The FDA, in general, is more tolerant towards innovation than the European Food Safety Agency”. He exemplifies this with that U.S. authorities have shown leniency towards new technology-based food and that the EFSA have been somewhat skeptical towards novel foods. In particular, food agencies in Europe have previously been reluctant of nanotechnologies and particles being applied in food. However, Nicolaï believes this is justified as there are too many unknowns. The technology of cell fermentation has existed for many years and can be controlled. According to Nicolaï, an evident explanation for the reluctance can be found in Europe’s long history of agriculture and the high degree of agricultural lobbying.

Especially in countries such as Germany and France, where there is a high degree of agricultural lobbying, there will be: “much more lobbying in favor of traditional food production rather than alternative food production”. Despite this, Nicolai still believes that sooner or later, these new technology proteins will become GRAS¹³ certified in the U.S.

Charola does not share this view entirely: “There are ways in which it [EU regulations] is more ready than America for example”. Despite the advancements in the U.S. by the FDA and USDA as of the regulatory framework in 2019, Charola points out that nothing has really happened in the 18 months since then. Even though the framework signals acceptance from the regulators’ point of view, the framework will demand much information from the companies that could result in delays. Charola highlights that a new EU law on novel foods has existed since 2015 that include cell cultivated products. Charola further explains this indicates that European regulators acknowledge that there will be new products on the market in the near future, which is beneficial for future commercialization. He does emphasize that it is still in its early stages and that only time will tell.

New Age Meats have not yet determined what to label their products as, but Alemlı reasons that the label choice will vary from company to company. There is currently no industry-standard name or label for cell-based meat products. Charola agrees that an industry standard name is still undecided. Alemlı hopes that this will eventually follow, but they do not have the market research needed to assess which kind of framing consumers would be most positively inclined towards. Charola says that the labelling of the products is dependent on the terms that regulators will allow. He believes the regulators will not allow cell-based meat products to be called meat as meat is not only muscle but also blood, connective tissue and fat. Charola reasons that even if the industry is prohibited from labelling their products as meat, the consumers will already associate the products to meat due to the shape. Charola says, “When you see a sausage you don't need to read that it is a sausage. You know it is a sausage because of the shape”. Instead, he believes there is a need to highlight how environmentally sustainable and ethical the products are from an animal welfare perspective as those are aspects that could attract consumers.

¹³ Generally Recognized as Safe

In summary, the regulatory challenges are of great importance, as without the legal support, the products will not be able to commercialize. Both the FDA and the EFSA have acknowledged cell-based meat and brought forward a regulatory framework, though it will require much information from the companies. This could lead to regulatory delays and setback cell-based meat products from proceeding to market. There is not a consensus around which market is best suited to introduce new cell-based meat products. Another hindrance is the labelling of the products, with reluctance from the meat industry to call it meat. The framing of the product could also affect consumer attitudes towards it.

7.1.3 Market challenges

Going forward, Aleph Farms identifies consumer acceptance and marketing as the greatest challenges. It is crucial to position the product and ensure they develop the right product accordingly. Similarly, if New Age Meats can combat the regulatory hurdles, then the next challenges would be to motivate consumers to adopt new behaviors and understand the benefits of the product. These would be challenges that the company would have to face in the long run. Biotech Foods third stage in their work plan concerns industrialization and commercialization. Charola says it is about: “propagate what you have done on a larger scale and put it into the consumers’ hands”.

Toubia explains that they do not envision cell-based meat to be a one-to-one substitute for conventional meat. Toubia believes that due to the pressures that industrial animal farming faces, its yield will lower in favor of more grass-fed, organic and high-quality ways to produce meat. However, Toubia points out that the demand for meat is stable in Europe and is increasing in the rest of the world. Based on that, he reasons that the meat industry will have two categories of meat in the future:

The slaughter-based meat which will be more focused on the extensive organic grass-fed type of practices, and cultivated meat or slaughter-free meat which will be a replacement of industrial farming for the mass market, but with a higher quality product.

These different categories will have different sets of attributes and value propositions, therefore not necessarily interchangeable or substitutable. Instead, Toubia believes they will coexist but target different sets of customers or contexts. When asked about how their product could impact the meat industry, Alemlı reasons in a slightly different way from Toubia:

From a cost basis, I think it will become a complement to start. But I think that just given the impact that farming has on our ecosystem and environment I do see the potential for us to be a replacement over time.

New Age Meats tries not to limit itself by focusing on a specific target group. Alemlı says that he hopes that any person that currently eats meat will also consume their products. As long as New Age Meats products can prove themselves competitive on the market, Alemlı sees no reason as to why consumers would not choose cell-based meat. They aim to be more affordable and better tasting as well as safer from a food-safety perspective and of higher quality than traditional farming products. There are a lot of additives in traditional farming products, which makes cell-based products safer and healthier to consume. Toubia further explains that the production method of cell-based meat is more efficient and requires fewer resources, and thereby has a lesser environmental impact. It is also better from an animal welfare perspective and does not require the use of antibiotics, he says.

Aleph Farms strongly believe in the importance of communication, especially to explain the correct facts of the process and the products. That was the underlying motivation behind the decision to open a visitor center to communicate full transparency and educate consumers on the alternatives to factory farming practices. Toubia says that factory farming itself has lost connection to the animals; an argument that the cell-based meat industry is accused of as its process originates from labs. Alemlı also believes that there is a need to communicate from different angles in order to educate customers about cell-based meat products. Naturally, New Age Meats will do their part from a marketing perspective and with public relations. Alemlı also suggests that cell-based meat will also be brought to the forefront of consumers' minds by in-depth news articles, positive press and science-based research. Thereby, he believes people will start to grasp the idea of what cell-based meat is as a product.

Charola mentions that around 65-70% of the Spanish population, according to market research, still have never heard of cell-based meat before. He believes the number is probably closer to 85% as another market research study showed that people over the age of 65 did not fully comprehend the concept of the industry. Charola believes that younger generations will truly recognize the potential of the industry and be the first cell-based meat consumers. Charola, therefore, agrees that the consumers need more information in order to understand this new industry. Charola believes consumers value the sustainable and animal welfare aspect of the products but needs more understanding of how the process works. The labelling of the cell-based meat products also affects how consumers view the products, as artificial and lab-grown are words consumers have negative connotations to. Therefore, he reasons that work has to be done to help customers understand the naturalness of the process— where the cells come from and how they duplicate to create muscle and proteins. Charola shares:

A lot of communication has to be done to bring more information into consumer hands, so they can make the decisions in consuming or not these kinds of products. A lot of work still has to be done there.

In summary, market challenges will follow but do not seem to be of great concern yet to the case companies. They believe that consumer acceptance will increase with the right communication and marketing strategy. In particular, it will be important to convey the naturalness of the products in order to minimize feelings of unfamiliarity. Furthermore, the vision of cell-based meat as the sustainable choice is believed to be in line with current consumer trends. It will, therefore, be more accepted and adopted by younger generations.

7.2 Theme B: How do the case companies view strategic partnerships and alliances?

Strategic partnerships in the R&D phase are vital, Nicolai explains. This is partly as the food industry in general, the dairy and meat industry in particular, are very competitive and face decreasing margins. As of this, the marketing and branding of a traditional product will allow for the extra margin necessary, which drives a more competitive marketplace. Nicolai describes that

strategic partnerships in the R&D phase will help speed up the commercialization process. Time and money may be wrong spent if an established company in the food industry remains to innovate solely with the know-how in-house, thereby the process can be speeded up by involving a start-up. The opposite is true for the start-up Nicolai explains: “If you are a start-up, the most important thing that you need is cash because the development and R&D are very capital demanding”. In that sense, partnerships in the R&D phase are mutually beneficial.

Nicolai highlights that the formation of the alliances can differ, from alliances with a high degree of interaction to pure contract research. In a partnership similar to a joint venture, there can be daily R&D collaboration between employees from both parties. Furthermore, there are also second-tier partnerships where there is a two-way flow of know-how between the parties, but that lack the equity division of a joint venture. Instead, Nicolai explains that there can be cross-licensing agreements where the intellectual property in both companies can contribute to the joint development of know-how. The last option could be pure contract research or licensing where the company ordering the R&D could take a minority stake in the company that is developing the technology.

Nicolai suggests that strategic partnerships in the R&D phase have increased over time because: “It is merely driven initially by the competitiveness of the market and the constant need for innovation; R&D and innovation drive profit by sales”. This applies to all industries, but especially to the food industry where limited product margins are maintained or increased through innovation. Without innovation or differentiation, there is only room for price competition, which for the vast majority of consumers will be the defining factor if no other benefit is presented. Thus, Nicolai reasons that breakthrough innovation can bring much needed profitability to a traditional business.

Another factor that has driven the increased tendency for strategic partnerships is, according to Nicolai, “the impact of the way that capital is available”. Bank loans may not always be efficient, which could leave a start-up with the choice of partnering with a private equity company, venture capital company, or seed funding to access capital. Nicolai continues that these companies will most likely demand a majority stake in the company upon providing capital, in order to be able

to exit after a couple of years and sell off the shares for a return on investment. An alternative way, Nicolai explains, is to gather minority stakeholders from larger corporations that have significant funds available. The potential downside of corporations' partnerships could be that they want to continue the work to commercialize the product, in contrast to an R&D alliance.

7.2.1 Partnerships for technical challenges

Aleph Farms sees R&D partnerships as part of a company's strategy, therefore, the variety in how these partnerships are formed will vary just as much as each unique company strategy.

Toubia says:

I believe that most of the companies are open and waking on different strategic partnerships in the R&D phase just because there are so many challenges to take care and overcome to bring the cultivated meat product to the market. It makes sense to partner and to share the resources, and to pull resources to address those challenges.

He also points to that their partnerships were motivated from a need to solve technological challenges. Charola suggests they have partnerships to help them solve the challenges they face: "In fact, we have partners in all processes". New Age Meats does not have any collaborations to help them at this stage, despite that their greatest challenge is to scale up production in the R&D phase. New Age Meats mostly does everything in-house due to the value and nature of their intellectual property. Strategic partnerships outside of the industry are under development but nothing is formalized and can therefore not be disclosed yet. Nicolai points out that the inability to disclose information about partnerships could be a request from the partner to avoid bias or if it is preferred to fly under the radar until it receives traction and scale. To publicly disclose information about partners could set high expectations on the company, especially if it is a high-profile investor that could put the company under pressure from media attention. Alemlı acknowledges that there are many risks involved in strategic partnerships during the R&D phase:

The risk is always things that happen outside of your company can become public. So, there is always a risk of what you are disclosing by entering those agreements that might tip off what you are doing to potential competitors.

Charola also mentions that risks are always present: “from the very first moment you enter, there are risks that have to be managed”. If the industry is serious about making an impact on a larger scale, then collaborations are key. Charola elaborates:

When you try to build a new industry in the first stage, I think you have to see this more as collaborations than competitions or you have to remain more open because it is not only about you to advance here. It is everybody: your providers, competitors, customers.

At Aleph Farms they try to find a balance of this risk through: “externalizing part of the R&D and partnering with other technology providers and making sure the core technology of the company will remain under the control of Aleph Farms”. They will keep direct ownership of the key critical intellectual property that is required to get the product to market and based on the science technology, developed together with Professor Levenberg, will result in the commercial product. Aleph Farms has a crucial collaboration with academia through the Technion Institute of Technology, a large university in the North of Israel. There is a high level of specific knowledge in the fields of tissue engineering, and stem cell research in Israel, which Toubia believes allows locational advantages for a cell-based meat company like them. The company was founded together with the Technion and are together with Professor Levenberg “the shoulders of the company”. Professor Levenberg is a leading scientist in the field of tissue engineering and Toubia explains that the competitive advantage of Aleph Farms largely resides with the collaboration with her. She is continuously involved with exploratory research at Aleph Farms to develop “advanced technological platforms for the second and third generations of our products”. The collaboration is a close one and one where her role is clear: “Professor Levenberg focuses more on the research per se, the more exploratory thoughts into new directions, which could help Aleph to sustain a competitive advantage in the future”. Aleph Farms is in the process of expanding partnerships with universities, and have started discussions with universities in both Europe and the U.S.

Similar to the geographical business advantage that Aleph Farms has in Israel, New Age Meats sees a benefit from the cluster they are submerged in. They are located in the East Bay area of

San Francisco, which is a massive draw for talent of a wide variety and is a desirable area for biotechnology companies. Alemlı suggests it is a great benefit for the company to be surrounded by a lot of biotechnological and high-tech companies as New Age Meats will be able to take advantage of the knowledge cluster that resides in the Bay Area.

As for technological R&D collaborations between the companies, Toubia points out that it is quite rare in the industry. This is because each company better structure their intellectual property, he explains: “It needs to solidify its unique differentiation for the market, so the collaborations today are not really on the R&D side, more on the go-to-market activities”. Nicolai explains that ownership of intellectual property is a critical factor in entering strategic partnerships. However, from his experience start-ups are sometimes financially unable to seek intellectual property rights because legal advice and patents are expensive to file for. To receive legal guidance can be necessary as patents need to be solidly written in order to prevent competitors from finding loopholes to work around a patent. Therefore, seeking partnerships can be a risk as start-ups fear their intellectual property will be stolen or exploited by an unethical partner, or even risk that the partner files rights for the idea themselves. If the start-up is willing and able to get protection for their intellectual property, Nicolai explains this can be: “the main leverage in negotiating with a future partner”. This is because it gives their business idea a unique angle and is key to secure the future of their business.

On the other hand, choosing not to file patents in a new industry, such as the cell-based meat industry, could be preferred because a patent discloses information to the common knowledge. This could be a tactic more applicable to an established company. In contrast, a start-up is in greater need to use intellectual property in negotiations down the line and as to develop future products. Charola agrees that intellectual property has to be considered carefully when entering collaborations and explains that they have a framework for their collaboration background with the specifics of intellectual property spelt out. Biotech Foods have the rights to all aspects that concern the cultured meat while being able to outsource the rest. Charola believes this approach could help all companies to flourish and enable product commercialization.

Alemli states that they do have ties with other companies within the industry, but that it is not an open-source of innovation by any means. New Age Meats are not engaged in collaborations with other cell-meat companies, and this is a choice taken from a legal business perspective.

Concerning the greater challenges to come, Alemli is positively inclined to share those with competitors. Still, Alemli reveals that there are some competitors that New Age Meats are more comfortable discussing matters with. Charola agrees that it is difficult to collaborate with other cell-based meat companies. He believes this is in part because it is a new industry with many trade secrets and without products on the market yet, hence there is nothing to benchmark against. Charola reasons that: “At this moment no one has gone public with what they have. In that situation, it is very hard to do a real collaboration with competitors”. To set the competition aside is furthermore complicated as all companies have unique processes and strategies even though the underlying technologies are similar. According to Charola, the Good Food Institute tries to encourage collaboration among cell-based meat companies, but as explained, it could prove rather difficult as every company would prefer to keep their intended market strategies secret.

To conclude, the one common denominator between the case companies in terms of strategic partnerships aimed to solve technical challenges is that they do not collaborate with other cell-based meat companies. The unwillingness to collaborate within the industry derives from the tough competition they face being in a new industry and that no one has gone to market yet. Most importantly, it is a matter of preserving ownership of their intellectual property, which is a key component of their competitive advantage. The trade-off between outsourcing and performing the process in-house is evaluated depending on accessibility to the needed resources. Both Biotech Foods and New Age Meats indirectly said they had partnerships in this regard but could not disclose information.

7.2.2 Collaborations for regulatory challenges

Toubia states that collaborations with other cell-based meat companies could be helpful if they are intended to work on industry standards such as terminology and building infrastructure for the industry on the regulatory side. Toubia believes this form of collaboration is important to build the foundation of the industry correctly from the start. As for regulatory challenges in

Europe, one of Aleph Farms future export markets, Toubia says there is work going on to address that. The regulatory situation in the U.S. has been lobbied for by strategic alliances such as AMPS Innovation in order to achieve the legal framework needed, which proves collaborations between cell-based meat companies could play an essential part to pave the way to market.

Charola agrees that it could become relevant for cell-based meat companies to collaborate to tackle regulatory challenges. Regulations constitute a great hurdle for the companies to overcome and is an area that demands many resources. There is also a need for a strategy that delineates how and when the company should enter the market; taking into account if it could be a strategic move to allow another company to enter first in order to create a benchmark, says Charola. Therefore, it might also prove difficult to collaborate with another company when it comes to regulatory challenges as there could be an unwillingness to share details of their strategies. Furthermore, Charola emphasizes that it is a complicated process to collaborate on as the products will most likely differ between competitors and therefore require different regulations.

In summary, the case companies were not as reluctant to partner with industry colleagues to influence legal aspects and industry standards as they were towards collaborations in the R&D phase. The motivation to enter partnerships in this regard is thus to utilize network effects and more effectively overcome legal-political barriers. It was however pointed out that it could still be difficult as the companies have different products and strategies. Therefore, they would want to influence regulatory standards that benefit their strategy the most – while simultaneously not disclosing too much information to competitors.

7.2.3 Partnerships for market challenges

In terms of the downstream development for the future, Toubia believes that each company will have a different market approach. “At Aleph Farms we do think that leveraging partnerships for distributing and supplying meat to the target markets is the best way to proceed”, says Toubia. Aleph Farms is working closely with the American agriculture corporation Cargills, and in

Europe, they have a partnership with the Swiss distributor Migros. Toubia states that partnerships are of importance in that regard.

Charola explains that Biotech Foods see themselves as suppliers of cultured meat to meat processors, which means they do not perform the full value chain themselves as Aleph Farms and New Age Meats. According to Charola, this is an intentional decision to leverage existing knowledge the meat industry possesses of the market and the customers. A business model was decided where the industry focuses on retailing and that Biotech Foods perform the innovative development that they have a competitive edge in, as Charola explains:

The industry has been working for a hundred years or more. I think it is very good to listen to those that have experience and that have done it, and that is why we have this business model.

Charola does point out that different business models can survive and co-exist in most industries, therefore, it is not a winner-takes-all situation. Biotech Foods depend on that their business model will give them an advantage and that it is a question of resources. Charola explains that to tackle, say, 1 % of the meat market would require a large capacity, which is difficult to obtain for a new company. Thus, if they would have invested in the whole process, it would have required a doubling of resources.

Charola admits that external interest in the industry has increased over the past three years. Charola believes stakeholders within the meat industry are already aware of the benefits of cell-based meat and says this is largely thanks to firms that supply plant-based meat that has paved the way for alternatives. He elaborates by explaining that Biotech Foods performed a survey during a talk they gave at a convention in Spain with 500 participants from the meat industry. It was an interactive talk where the study revealed that 80 % of the participants see it as likely that cultured meat will be in the supermarkets in the future. Biotech Foods have also outsourced their market research to specialists. This was done in order to help the company reach more than 1000 consumers to receive a greater understanding of consumer perceptions.

In regard to the meat industry stakeholder interest in the field, Alemlı believes that larger meat corporations will become more forward-thinking and eventually recognize the importance of cell-based meat. He reasons that meat corporations realize that the current progress could threaten their business, and instead of resisting the transition to more sustainable options, they take part in the change. Charola agrees to state that cultured meat is not something the traditional meat industry is against but something they seek to be part of. Alemlı sees cell-based meat as a disruptor to the traditional meat industry and therefore believes that interventions, as well as job retraining will be necessary once the industry changes. To biologically grow meat in a clean industrial setting is different from traditional farming methods and will most likely replace part of the conventional meat's value chain in favor of new stakeholders. However, Alemlı believes that family farms will take less harm from the introduction of cell-based meat compared to industrial farming.

Toubia also confirms there is an increased awareness of the cell-based meat industry's progression from external partners, from all across the globe. There are quite a few meat companies that have reached out to Aleph Farms and expressed interest to partner up to innovate on new ways to produce meat. Toubia believes the meat industry today is aware of both its limitations as well as the bad image adhered to its negative consequences on sustainability and animal welfare. He believes that they are more willing to address those issues today with sincere intentions. Meat stakeholders face pressure to contend industrial farming practices, which Toubia believe are demands that derive from both consumers and governments. He gives examples of the German state discussions on taxation of meat to combat its environmental impacts, or petitions from Swiss students to ban industrial farming in the country. At Aleph Farms, they are open to collaborate with meat companies that ally with their vision and that are interested in implementing and promoting more sustainable ways of producing meat.

Nicolai views the meat industry has expressed interest from a competitive standpoint, that is, that the traditional industry scans for the future competition that could disturb their business. He continues to say that the competition they monitor does not come from traditional competitors, but the alternatives. Nicolai suggests, with an example of the dairy industry, that there is concern that consumers will opt for plant-based alternatives rather than traditional milk to a larger extent

in the future. That would explain why large corporations such as Nestlé and Danone can be seen investing in plant-based or non-dairy products because they proactively scan the market for opportunities to expand in the direction. If consumers demand the alternatives, then it is desirable to be a leading part of the next trend in consumption or wave in technology. Nicolai reckons that the downstream challenges will be dealt with the partners' financial help. He continues:

That's why Cargills, Nestlé and investing enterprises are choosing to invest in this, because they know that once the technology is sound and the legal circumstance is clarified it is just about mass production and distribution to adapt the new product.

Meat industry stakeholders may want to strategically seize the potential to expand their core business to stay competitive towards the threat from the alternatives. Therefore, industry stakeholders scan the market proactively to discover new trends of food consumption that could help them diversify as a company. Strategic partnerships entered with external parties from other industries are rare, says Nicolai, as they have an entirely different supply chain. For Tyson Foods, Cargills and Nestlé to partner up make equal sense to both parties, because they have a similar supply chain, distribution to market and knowledge about customer preferences and marketing. Thus, an external partner that cannot bring networks or knowledge will find it more difficult to help the product to market.

Aleph Farms have taken a unique approach helping with the market challenges that lay ahead – a Generation Z Advisory Board. Toubia explains that their sustainability focus is to build and provide a better world for the younger generations to: “leave a healthy legacy of our planet to their children”. They value all sustainability aspects equally and therefore seek a systematic and global sustainability strategy. Toubia continues: “We felt like it was important for us to identify the leaders of the new generation globally and to have them involved in building that vision for the next generation”. The Generation Z Advisory Board enables this by involving young representatives to share insights that will help to shape Aleph Farms as a brand of their generation – and for generations to come.

Partnerships with stakeholders from the food industry in general, and the meat industry in particular, were commonly mentioned to solve market-related challenges. This was believed to be attractive as to leverage the knowledge, marketing strategies and distribution channels that these stakeholders already possess. Thus, the motivation to enter partnerships in this stage stems both from resource and knowledge acquisition, but also to gain access to networks in order to develop supply chains. A key finding was that market challenges may not be as difficult to overcome with the financial and strategic help of partners. The case companies view the meat industry's involvement as a reactive attempt driven from external pressure to correct their non-sustainable industry practices and the negative externalities of meat production. On the other hand, it was reasoned the meat industry's inclination to partner up stems from a more proactive approach; to scan the market for competition and leverage innovations to extend their business model.

8. Concluding remarks

This study revealed that the case companies face several technical, regulatory and market-related challenges that bring about different needs for external partnerships. The most critical issue to solve is how to scale up production in a cost-efficient manner, in order to enable them to reach end consumers at a competitive price. The findings showed that strategic partnerships and alliances could help to overcome some of the challenges and are believed to better the odds to reach the market. This is believed to facilitate the shift towards more sustainable meat alternatives in the long-term. These findings will be discussed below in relation to what previous literature and theory have found to establish correlations– and differences. The discussion will also suggest where there is a gap for future research to fill and conclude the answers to the research question the thesis set out to present.

Strategic alliances and partnerships matter

The case companies' view was consistent with the secondary data findings, which is that strategic alliances and partnerships are important for cell-based meat companies to progress and overcome their challenges. Both Charola and Alemlı indicate that they have partners in all processes but were unable to disclose further details. Charola further emphasizes that collaborations are key in order to achieve the industry's vision of becoming a sustainable solution that will have a significant impact on the current system. Toubia also states that collaborations are central to build the foundation of the industry correctly from the start.

The literature highlights that the need to enter strategic alliances is particularly essential for biotech start-ups in the R&D phase, as they lack the funds needed for the complex technology as well as face sunk costs implied in the product development process (Rudny, 2016). This concurs with the findings that explain that strategic partnerships are vital in the R&D phase, especially in the meat industry. Further, Nicolaï stated that the increased need for R&D partnerships could be explained by: "It is merely driven initially by the competitiveness of the market and the constant need for innovation. R&D and innovation drive profit by sales".

Strategic alliances are of great benefit for companies in the R&D phase to access technical knowledge (Oxley & Sampson, 2004) and cope better with changing technical environments (Das & Teng, 2000). They are also useful to achieve technical breakthroughs (Todeva & Knoke, 2005) and maintain and gain a competitive advantage (Cobeña et al. 2017). These were reasons brought up by the case companies as determinants to enter partnerships in the R&D phase, in particular, to ensure a competitive advantage. Aleph Farms partnership together with Professor Levenberg is the clearest example of how a successful strategic partnership helps them stay at the forefront with their technology.

Toubia further confirmed that partnerships help them cope with challenges as to achieve progress: “It makes sense to partner and to share the resources, and to pull resources to address those challenges”. According to the resource-based view of strategic alliances, each firm can be seen as a pool of resources (Yasuda, 2005) and firms in high-tech industries can benefit from accessing these resources through an alliance (Ma et al. 2011) to contribute to new product development success (McGee et al. 1995). The motivation to enter into strategic partnerships could thereby be seen as in line with the resource-based view, to combine firms’ resources for potential value-creation (Das & Teng, 2000).

Intellectual property driven field hinders industry collaboration

Even though R&D alliances could accelerate technology development, especially in high-tech industries, there are certain risks involved (Oxley and Sampson, 2004; Vilkmam & Keil, 2003). Inherent risks with a strategic alliance include leakages of unplanned knowledge (Lioukas & Reuer, 2020) and a firm’s IP rights (Stephens, Sexton & Driessen, 2019). These risks were confirmed in this study to be present in the company’s decision-making process to seek partnerships. There is a common consensus amongst the case companies that entering into a strategic alliance with another cell-based meat company in the R&D phase is not optimal from a legal business perspective, as they want to protect their intellectual property. Intellectual property constitutes a competitive advantage, and the case companies are all in agreement that this entails the technology should preferably be developed in-house. Rudny (2016) highlights that the competition for funds for biotech start-ups is fierce, which could also play a part in the

unwillingness to collaborate within the industry. This is further amplified as it is a new industry and that no products have yet been displayed to the market, as Charola pointed out.

As covered in the theory section, Mody (1993) argued that the number of strategic alliances in an industry is partly dependent on whether other players have entered collaborations, so-called demonstration effect, as well as the compounding effect of network externalities. For the cell-based meat industry, this notion could imply that the more established the industry becomes, the higher the likelihood for further partnerships. Charola pointed out that as it is a new industry with a high degree of trade secrets, it is just not feasible at this stage to collaborate within the industry. This despite external pressures to do so, for example, from the Good Food Institute, in belief to create a snowball effect and accelerate progress. Once the critical phase of commercialization has passed, this view might change as more stakeholders join the industry.

Regulatory advancement determines market readiness

The case companies and secondary data gave considerable insight into how extensive the regulatory challenges are. Toubia and Charola emphasized the importance of collaboration to overcome them in order to put pressure on legislators to acknowledge this new group of products and to pave the way for the cell-based meat products to market. Case companies were also willing to partner within the industry to face legal-political barriers as well as to build industry standards as their intellectual property is less at risk in these types of collaborations. It was concluded that it is a long-term process.

It was made clear that some countries and regions have advanced in their development of regulatory frameworks to accommodate cell-based products than others. This presents an interesting aspect of how this could consequently affect cell-based meat companies' market entry and export strategies. As was brought up in the interviews, the FDA is regarded as more tolerant towards new food innovations than the EFSA, which could affect how well-received future generations of cell-based products will be. Countries that are forward-leaning and welcome innovations could perhaps become leading markets for these new products. That legislators in certain regions show a willingness to accommodate innovations may further foster an environment that attracts more innovators and start-ups that develop new food technologies.

This thesis primarily focused on the U.S. and EU markets. There are, however, cell-based meat companies that operate in Asia and South America, which face different cultural prerequisites that would need to be taken into consideration for regulatory adaptations and consumer acceptance. Emerging markets in Asia and South America with their increasing demand for meat (World Economic Forum, 2019) would seemingly be considered target markets with high potential. However, it should be noted that meat consumption has deeper cultural associations that can present difficulties and may well demand a different strategy in regard to regulatory and market adaptations than in Europe and North America. For example, in China meat represents economic advancement, in Argentina, it is associated with celebration, and India's national food culture of vegetarian dishes will likely alter the way cell-based meat companies can market their products in these countries (Alvarez & Kindred, 2019). For future research, market entry in emerging markets could be an interesting and relevant topic to investigate both from a business strategy view, but also a cultural consumer behavior perspective.

Partnerships with the meat industry gives access to key resources and knowledge

The study found a lack of collaborations between cell-based meat companies in the R&D phase. However, it revealed a high level of partnerships between the cell-based meat industry and the agricultural meat industry. There seems to be a mutual interest to partner up to progress this field and evolve together. This confirms the observation by Segers (2013) that the biotechnology field is moving away from a high tendency of contract research conducted by smaller firms on behalf of larger firms, in favor of more open innovation models. The interplay of different stakeholders and institutional groups that are involved in the cell-based meat industry, ranging from universities, non-profit organizations to venture capitalists and food corporations, further suggests that the field is evolving into a more open approach, as suggested by Segers (2015).

The cell-based meat companies' motivation to enter into strategic partnerships with meat industry stakeholders at this stage can be explained by the need to access resources and knowledge about retailing, marketing strategies and distribution networks. This strongly correlates to the resource-based view (Das & Teng, 2000) and learning argument (Mody, 1993) from the literature. The case companies insinuated that they believe meat industry stakeholders

have partnered up reactively, to correct the flaws of their own industry by investing in a more sustainable choice. A more proactive angle was also suggested, that the meat industry stakeholders scan the market for investment opportunities in line with food trends and technology advancements that could help broaden their business model. Regardless of the initial intentions for meat industry stakeholders to partner up, it is interesting to forecast what a long-term partnership could mean for the industry as a whole— and how it could progress forward. Given the increasing competitiveness in the food industry in general and how margins are largely increased by investing in differentiation or innovation, it could be assumed that partnerships with the food industry will continue to increase in the future.

Partnerships today could influence the value chain of tomorrow

If one regards the evolution of the industry from biomedicine research at universities, to the development of the start-up scene that is now in its inception to begin commercialization, it can be relevant to consider a coming third wave for the field (Stephens, Sexton & Driessen, 2019). If it was biotechnology or biomedical researchers that dominated the first wave, then tech-oriented stakeholders and venture capitalists that played an important role in the second wave; which institutional stakeholder group will mainly drive future stages? According to the data collected by the case companies, it is reasonable to assume that the meat industry stakeholders and retailers will shape the future of the industry. Time will tell if the high level of partnerships between the cell-based meat industry and agricultural meat industry stakeholders will result in the new industry molding in to fit the current value chain, or if it will play a part in establishing a new normal.

Once cell-based meat products establish themselves on the market and can operate without the necessary need from seed funding, accelerators and the associated fundamentals for a start-up, questions appear of what a future value chain and industry infrastructure would form. Alemli highlighted that if cell-based meat successfully disturbs the traditional factory farming, it could have a profound impact on the stakeholders in the current value chain. Both Alemli and Toubia believed that there would be a change in the market share of different product segments. Locally produced meat from family farms, preferably organic and grass-fed, is believed to increase in the future in favor of factory farming. The stakeholders that would be most affected by a

transformation of the current meat industry would thus be the industrial meat corporations and its farmers as well as suppliers of traditional agriculture equipment. This understanding shed further clarity over meat stakeholders' interest in this new industry, as they seek new revenue streams if current ones would be affected and thus extend their business models, an aspect mentioned in the interviews. As the cell-based meat field is still in its beginning phase, this remains an area for speculation, but one that should have important implications for future research. Will the cell-based meat industry be able to disrupt the industry in its entirety or instead become a complement to traditional meat products?

Developing a new product– or a market segment?

There are different paths that cell-based meat products could take to the market. Stephens, Sexton and Driessen (2019) suggest that apart from establishing themselves as a category on its own, cell-based meat companies could choose to license or sell the technology, perhaps to meat processors that seek to vertically integrate their business. It is also possible that partnerships are deepened and that these products fit into existing categories, or as a sub-category that is still dominated by traditional meat products. The case companies pitch their products as having disruption potential and are projected to compete as a category on its own next to meat. It has been exemplified that innovative companies which focus on downstream activities for the innovation, rather than to develop the product without a market in mind, is better fit to establish a new market segment (Goedertier & Geskens, 2010). Biotech Foods was particularly clear in their interview regarding having already established a clear business model of themselves as suppliers to traditional food processors. Thereby, they can allocate resources otherwise spent on end-consumer marketing, sales and services towards establishing B2B relationships with processors. The CEO of Biotech Foods believed this market approach would be their key competitive advantage once their product is finished.

Whether cell-based meat products become complements to meat in the form of niche brands, or if this new industry will be concentrated to a few key players is too early to judge. It could in part be dependent on how well received the products are by consumers, and if not, how the unfamiliarity will be tackled. It was made clear in the interviews that to overcome market-related

challenges such as consumer acceptance, effective and transparent communication will be critical.

It was also brought up that partnerships with meat stakeholders in particular that have the marketing and retailing expertise is considered valuable to help cell-based meat products in an initial stage. To have partnered up with an experienced meat stakeholder with marketing and retailing expertise could perhaps become critical to convey that familiarity and better consumer attitudes if brand loyalty of the meat product reflects upon the new product as well. This resonates with findings from the literature review that found channel relationships be sought to access new distribution channels to shorten lead time to market (Agarwal & Singh, 2014). However, the findings do not as strongly confirm Newmeyer (2011) idea that firms seek partnerships with a strong brand to capitalize on the brand value, but perhaps to some extent for brand management capabilities as Biotech Foods pointed out they lack knowledge of. This notion was confirmed in a study on downstream innovations, which established that introduction of new products to consumers could be eased by positioning it as a subcategory of a known product (Goedertier & Geskens, 2010). One can thus argue that the resemblance and connection to meat will be favorable for cell-based meat products as it helps the consumer to connect, accept and categorize this innovation cognitively. Again, this is an idea that could be tested a few years down the line when the products have commercialized and is a recommended topic for future research.

Meat the future

The cellular agriculture field could represent a profound shift in what encompasses the definition of food production. If cell-based meat products succeed in the marketplace, it could very well become a benchmark for further investments into food technology and inspire subsequent research into the field. How well external stakeholders have shown interest in the field through investments and partnerships could furthermore signal a willingness to explore new sustainable solutions. Innovations in the food sector, both in products and processes, could also emerge as a result of the unprecedented times we are currently in with the COVID-19 pandemic. It is possible that value chains will, to a more significant extent, become regionalized or localized, and that more emphasis on a country's degree of self-sufficiency will follow. As cell-based meat

production is unaffected by factors such as climate and agricultural prerequisites, it could prove to itself to be a timely solution that is theoretically possible to produce anywhere. This is a relevant topic for future research that is highly encouraged to pursue.

Conclusion

The purpose of this study has been to investigate and understand the importance of strategic partnerships and alliances within the cell-based meat industry in an early R&D phase. The findings have been applied to see correlations and outliers against existing theories and literature on the topic. Though the findings are based on cases and are thus, to some extent firm-specific, a considerable amount of the results can still be made generalizable to the whole industry. This is argued as the industry is quite small and that all companies or start-ups are still in the R&D phase to a varying degree.

The first research question set out to investigate what challenges cell-based meat companies face in the R&D phase. Once the challenges were established into a threefold category, they were examined to understand how they motivate companies to seek strategic partnerships and alliances to resolve them. Within the scope of this thesis, it was found that the technical challenge of scaling up production in a cost-efficient manner is the dominant focus at this stage. In this regard, strategic partnerships were deemed necessary to ensure a competitive advantage and to better the odds of commercialization. There were however no strategic alliances pursued with other cell-based meat companies since this was regarded as troublesome from a legal business perspective. Intellectual property constitutes the case companies' competitive edge, and direct ownership of it is crucial, both as leverage in partnerships and to seek investments. To not risk that a competitor will appropriate the technology, industry collaborations were not preferred, which is a finding that distinguishes itself from prior research on start-ups within the biotech and high-tech sectors.

A different strategy was present for the regulatory challenges that proved key for commercialization. Strategic partnerships and alliances in that regard are welcomed as to establish industry standards and to pressure regulatory frameworks to acknowledge this new field appropriately. Lastly, market-related challenges were mapped out and considered important, yet

not the barrier that previous research has established it as. This study found that a considerable number of the industry's partnerships are with stakeholders from the traditional meat industry. The main argument for seeking these types of partnerships is to acquire knowledge and resources as well as access to networks and distribution channels that are vital for the next stage of commercialization.

In summary, cell-based meat companies seek to enter strategic partnerships and alliances to solve the challenges they face. However, the choice of partner and how the partnership is organized differs depending on which challenge it aims to solve. To a large extent, the reasoning correlated with the resource-based view of entering strategic partnerships and alliances. This thesis contributes to academic research by providing new insights into the industry that have previously not been accounted for. It hopes to encourage more business-related studies within the field, as business considerations will be of increasing importance now that the field is approaching the market. Not only should this research be followed up upon and elaborated on as the industry progresses further, but there are many interesting topics for future research that have important implications for the future of the field. Furthermore, a similar research approach could favorably be applied for other innovation areas that are in a pre-commercialization phase.

Climate action failure, environmental risks, population dynamics and health risk present the greatest challenges for the global society today (WEF, 2020; FAO, 2009). Meat consumption is both the cause and effect that drives the meat industry's negative contributions to the global challenges we face (Froggatt & Wellesley, 2019). There is a need to transition into more sustainable alternatives to meat— for our health and the planet's health. Innovation is the key driver for change in the 21st century and has proven to alter the status-quo in the past (FAO, 2017). Whether the cell-based meat industry has the potential to be that much-needed change is too early to tell – but it undeniably shows much promise.

Cell-based meat could prove to become a benchmark for new food technologies that are driven by the vision to provide healthier, safer and more sustainable food alternatives. In order for cell-based meat to stay at the innovative forefront, partnerships are needed to access resources and knowledge. Mass markets will need to be reached in order to have a positive impact on a grander

scale, and that is not feasible for start-ups with limited financial muscles. Strategic partnerships and alliances can elevate what cell-based meat companies envisioned. As these challenges will continue to be the defining questions for generations to come, it is reasonable to conclude that this will not be the last food tech innovation that sees the light of the world— but rather the beginning.

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Appendix A: Interview guide

In short, how important would you say that strategic partnerships or alliances are in an early R&D phase?

Are there any stages that are particularly important to collaborate on?

Are you part of any strategic partnerships today or alliances today?

- What was the main motivation behind the decision to enter that partnership?
- Acquisition of resources vs absorption/learning

How important is collaboration with academia?

Do you have any collaborations with other cellular based meat start-ups?

- Why or why not?

What do you view as a risk of entering a partnership or alliance at this stage?

What is your view on open innovation?

What is your view on the advantages of performing vertical integration on your process versus to collaborate with external partners and suppliers?

- The disadvantages?
-

Given your location, would you say there are any geographical advantages that have helped you?

Do you see the need for future partnerships once you aim to go to market that would enable you to do so?

What is your view on the legal-political barriers and could strategic alliances play a role in overcoming those barriers?

For the future of this industry, do you see any strategic collaborations that you would need to enter once products hit the market?

- i.e. Supplier networks, trade organisations

Appendix B: Presentation of thesis

THE WHOLE IDEA

Objective
Investigate the importance of strategic partnerships to combat challenges that innovators face in an early R&D phase.
Provide insights to what industry stakeholders reckon are the opportunities and challenges that the industry faces, and project future needs for strategic partnerships and alliances

Background

- Sustainability, population dynamics and health issues: pressing challenges for the global society
- Risks food shortages and inability to fight climate change
- Meat consumption is growing with heightened living standards and growing middle class in emerging markets
- Transition to sustainable alternatives to meat needed
- Cell-based meat- new industry aimed to tackle these challenges
- Strategic partnerships and alliances proven useful in early R&D phase

Problematization

- Academic papers fails to account for the current status of the industry
 - New industry with start-ups that require funds to grow
 - What stands in the way for products to commercialize?
 - What resources are needed to get here?

KEY THEORETICAL POINTS

Objective
What does existing literature say about strategic partnerships and alliances in the R&D phase?
Allow for cross-checking empirical data with theories to discover correlations, gaps or outliers.

WHY?
Strategic alliances and partnerships conducted in the R&D phase could be critical to the process and to go to market quicker.

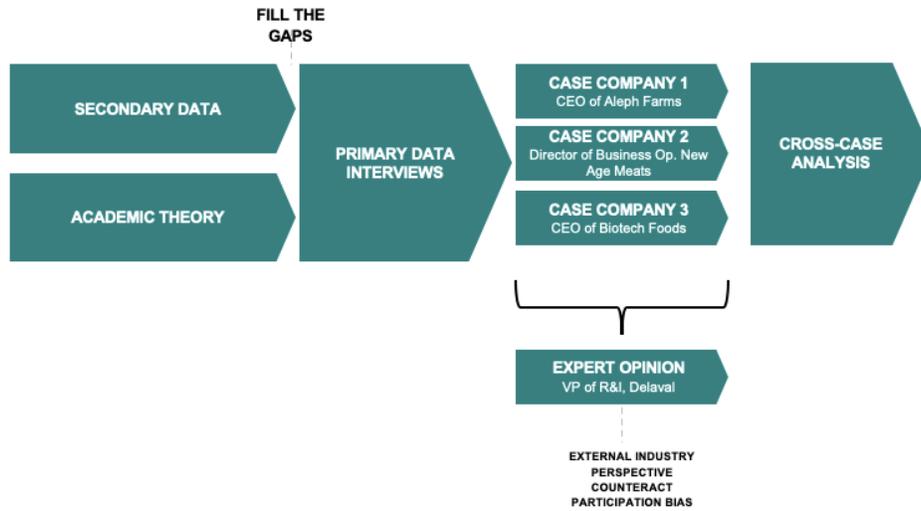
BENEFITS?
The main benefits of strategic alliances are knowledge creation and sharing, access to resources and capital as well as from a strategic long-term growth perspective.

RISKS?
The risks of entering a strategic alliance or partnership in the R&D phase concerns intellectual property rights and the fear of innovation being appropriated by the partner firm. There is a trade-off between access and absorption of resources and knowledge on the one hand, and loss of competitive advantage and IP rights on the other hand.

HOW?
An emergent trend in the biotechnology sector has been to opt for more open innovation types of partnerships, rather than a one-way transfer from a small firm to a large firm.

QUALITATIVE RESEARCH

Thematic analysis



Disposition analysis

Analysis					
Theme A			Theme B		
R1: What are the challenges that cell-based meat companies face during their R&D phase?			R2: How do these challenges motivate entry into strategic partnerships and alliances?		
A1: Technical challenges	A2: Regulatory challenges	A3: Market challenges	B1: Strategic partnerships for technical challenges	B2: Strategic partnerships for regulatory challenges	B3: Strategic partnerships for market challenges

Results

Cross case analysis

Theme A			Theme B		
What are the challenges?			How do these challenges motivate entry into strategic partnerships and alliances?		
A1: Technical challenges <ul style="list-style-type: none"> • Most dominant challenge • Scaling up production in cost efficient manner • Develop the right product with taste and texture 	A2: Regulatory challenges <ul style="list-style-type: none"> • Second most important • Prerequisite to commercialise 	A3: Market challenges <ul style="list-style-type: none"> • Considered doable with the right marketing and communication strategy 	B1: Strategic partnerships for technical challenges <ul style="list-style-type: none"> • IP and competitive landscape influences level of partnerships in this regard 	B2: Strategic partnerships for regulatory challenges <ul style="list-style-type: none"> • Industry partnerships welcomed in this regard to influence industry standards + legal-political barriers 	B3: Strategic partnerships for market challenges <ul style="list-style-type: none"> • Partnerships with meat industry stakeholders provide networks, distribution channels and retailing expertise

CONCLUDING REMARKS: DISCUSSION

Objective of this section

Discuss our most interesting findings, connect to theory to find correlations and outliers, speculate on the future – how can the findings be applied and used

Strategic alliances and partnerships matter

- Correlates to literature on that it is an important aspect in the R&D phase to gain resources, especially funds, but also distribution channels, and knowledge to advance product development

Intellectual property driven field hinders industry collaboration

- To protect IP and competitive advantage, industry collaborations are not pursued. Partly correlates to literature on fierce competition in biotech
- As previous research, stated network externalities and demonstration effect could change this notion in the future

Regulatory advancement determines market readiness

- Industry collaborations pursued to overcome legal-political barriers that were more extensive than thought
- Some regions/countries are more advanced in their regulatory adaptations, than others, which could influence market entry and export strategies
- Countries with a higher willingness to accommodate new innovations could become leading markets and foster environment for future innovations

Future research

Intellectual property driven field hinders industry collaboration

- Investigate if industry collaborations and open innovation models are pursued to a larger extent once the industry gains momentum and is established

Regulatory advancement determines market readiness

- Thesis focused on US and EU markets, but interesting to investigate prerequisites for Asian markets – as they face the highest increase in demand for meat, but are also experiencing sub-cultures moving towards plant-based
- Will cultural associations to meat play a role in how well cell-based meat is welcomed in other countries?

CONCLUDING REMARKS: DISCUSSION

Objective of this section

Discuss our most interesting findings, connect to theory to find correlations and outliers, speculate on the future – how can the findings be applied and used

Partnerships with the meat industry gives access to key resources and knowledge

- High-level of partnerships between cell-based meat industry and traditional meat industry correlates to RBV and Learning argument.
- High competitiveness and fight for margins in food industry imply investments into innovation diversification will continue

Partnerships today could influence the value chain of tomorrow

- Industry is progressing into its third wave development, and food industry stakeholders will be the new institutional influence
- This will impact how the industry, the value chain and existing market shares are formed

Developing a new product– or a market segment?

- Different paths to market: licensing, sub-category or create a new market space.
- Downstream innovations more market ready
- Partnerships with meat stakeholders could reap brand equity benefits

Meat the future

- Become a benchmark for new sustainable food-tech innovations

Future research

Partnerships with the meat industry gives access to key resources and knowledge

- Why has the traditional meat industry decided to partner up with cell-based meat companies - reactively or proactively?

Partnerships today could influence the value chain of tomorrow

- How will the current stakeholders in the traditional meat industry value chain be affected by cell-based meat entering the market. Disrupt? Disturb? Complement?

Meat the future

- Will/Could cell-based meat products be a solution to the global challenges we face today?
- Effects of COVID-19 on global food supply chains– regionalized value chains and focus on degree of self sufficiency could provide great timing for cell-based meat that is independent of agricultural/climate prerequisites

CONCLUDING REMARKS: CONCLUSION

Objective of this section

Conclude our most interesting findings, connect to introduction and answer our RQ:s - give a broader perspective to our thesis with concluding paragraph.

RQ1:What are the challenges that cell-based meat companies face during their R&D phase?

- Challenges could be divided into three categories:
 - Technical
 - Regulatory
 - Market

RQ2: How do these challenges motivate entry into strategic partnerships and alliances?

- Cell-based meat companies seek to enter strategic partnerships and alliances to solve the challenges they face. However, the choice of partner and how the partnership is organized differs depending on which challenge it aims to solve.

THE SO-WHAT TEST

RQ answered= check

Contribution?

This thesis contributes to academic research by providing **new insights** into the industry that have previously **not been accounted for**. It hopes to encourage more business-related studies within the field, as **business considerations will be of increasing importance** now that the field is approaching the market.

Relevant for future research?

Not only should this research be followed up upon and elaborated on as the industry progresses further, but there are many **interesting topics for future research that have important implications for the future of the field**.

Possible application to other fields?

Furthermore, a similar research approach could favorably be applied for **other innovation areas that are in a pre-commercialization phase**.