LUND UNIVERSITY
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Disrupting or Disturbing?

AN EMPIRICAL STUDY OF THE DISRUPTION POTENTIAL OF ENVIRONMENTAL SUSTAINABILITY INNOVATIONS ON THE DAIRY VALUE CHAIN

by

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June 2019

Master's Programme in

International Strategic Management

Word Count: 24,560

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Abstract

This qualitative multiple case study has identified and examined two environmental sustainability innovations and their implications on the dairy value chain by utilising an abductive research approach. For this purpose, plant-based and cellular agriculture innovations in the U.S. dairy industry served as the case objects of the study and were analysed in terms of their disruptivness. Thus, plant-based is a business model innovation in form of a high-value alternative to dairy with the proven potential to *disturb* the dairy industry. Cellular agriculture instead is a technological innovation that displays a substitute to dairy and has the ability to *disrupt* the dairy market. Furthermore, the implications the two cases entail for the upstream value chain were assessed in order to evaluate and compare the innovation's disruptiveness. Consequently, the study derived that cellular agriculture entails the strongest implications for farming and transporting, as they become redundant in theory, but displays an opportunity for large processing actors. In contrast, plant-based innovations encompass less implications to the upstream value chain as the innovation only requires another form of farming. Nonetheless, both innovations negatively contribute to the already occurring creative destruction of small farmers due to increasing developments towards industrial production. Subsequently, the discussion was completed by revisiting the previously recognised causal relationships between environmental sustainability, innovations, industry value chain and business strategy. Conclusively, the research aimed to broaden the theory of disruption by highlighting that high-value innovations can be characterised as disruptive, however their realised effect disturbs rather than disrupts the market. Furthermore, it acknowledges that innovations can be considered as disruptive even if they do not creatively destruct a whole market, but replace established products to a certain percent of the market share. Therefore, the research entails that innovations can have the attributes of a disruptive innovation but their realised effect is only disturbing the market.

Key Words: Disruptive Innovations, Environmental Sustainability, Value Chain Implications, Disruptiveness, Disturbing Markets

Acknowledgements

First and foremost, we would like to thank our *supervisor* Magnus Johansson for his continuous support and assistance throughout the process of this study. His guidance, advise and professional notion contributed significantly to the quality of this thesis.

Furthermore, we would like to express our gratitude to our *families* for the continuous moral support and encouragement throughout the whole study. It was their strong backing which represented a source of strength and motivation to proceed even in difficult times.

Lastly, we would like to thank our *friends* and *peers* for the fruitful debates, the continuous exchange and for lending us their sympathetic ear in these demanding times.

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1 Introduction

1.1 Background

Fifty years hence, we shall escape the absurdity of growing a whole chicken in order to eat the breast or wing by growing these parts separately under a suitable medium.

—Winston Churchill, 1931

In an ever-changing world that is continuously benefitting from a globalized network, allowing for trade, economic relationships, worldwide transportation and cultural exchange, the notion of environmental sustainability has become increasingly apparent. In recent years, the matter has evolved into an evident issue as the concept of climate change expanded into an immediate challenge worldwide (UN Environment, 2019). Therefore, both consumers and companies are increasingly aware of the challenges of conducting a sustainable business, which has fueled a large discussion about where the responsibilities lay and how one best mitigates the emerging issues (Chandler, 2017). Thus, while maintaining an economic advancement the challenge nowadays is to protect the scarcity of resources and thus provide long-term value for the environment. As industry experts, such as Porter and Claas van der Linde (1999) already recognised, pollution and waste are signs of inefficient use of resources. Therefore, as the basis for a sustainable development a focus should be put on creating long-term value instead of short-term value. This development can be further supported by promoting new technology innovations, while simultaneously reducing waste through incremental improvements, which ultimately should result in a competitive advantage (Porter & van der Linde, 1995).

One market in which a large global debate has been recognised is the dairy industry. This is due to the high emissions livestock farming and processing entails (Russel, 2014). As one of the largest dairy producing countries worldwide, the United States is, amongst others, constantly in the centre of attention when reviewing the concept of environmental

sustainability (USDA, 2019). Considering their relatively high production volume the U.S. is not only increasingly affected by sustainability-related consequences but instead, as a developed country, could also be considered as the driver of change worldwide. In fact, the continuously declining retail sales of dairy products in the U.S. and the increasing interest in specialty milk could already be signs of shifting consumer demand (USDA, 2019) in an industry characterised as inert and conservative. Thus, increased animal welfare, health concerns and environmental damages are factors now driving the need for not only incremental improvements in emissions from production but also innovative products and food technologies focused on tackling the challenges with a transformational perspective. This development has motivated product innovations in terms of offering plant-based alternatives as well as even more transformational products such as artificial production of food and dairy. Therefore, since the innovative products represent valuable substitutes to the dairy industry these trends and upcoming innovations may have the potential to challenge or disrupt the traditional dairy market.

Consequently, a significant change to a market introduced by new innovative actors is known as creative destruction (Schumpeter, 1942). This phenomenon occurs when rigid incumbent firms, products or services are replaced by new ones that are characterised as new forms of products, services or processes. This creates uncertainty in the market leading to potential obsolescence of old actors, products or services. While the concept of replacing an old innovation with a new one is referred to as creative destruction, the process of starting a new technology s-curve with new or alternative offerings can be specified as rooting from disruptive innovations (Christensen, 1997). With this in mind, Markides (2005) extended the concept of disruptive innovations by stating the need for distinguishing between business model innovation, technological innovation and radical product innovation. These innovations can yield first- or second-mover advantages by reaping relatively differing market shares, which depend on the type of innovation and its subsequent consumer adoption (Kerin, Varadarajan & Peterson, 1992; Rogers, 1983). The consumer adoption is in itself illustrated through the trajectory of an s-curve, indicating that consumer acceptance over time yields larger market shares and competitive advantages (Schilling, 2017).

With disruptive innovations in mind the U.S., especially California, is seen as a pioneer in food technology (Cooper A) and provides a place for firms aiming to challenge large and established traditional actors by developing new ways of producing food. These are firms

such as Beyond Meat, providing meat without beef, Just for all, producing eggs without chickens and Perfect Day Foods, processing milk without a cow (Beyond meat, 2019; Justforall, 2019; Perfect Day Foods, 2019). The latter example, Perfect Day, has introduced a protein innovation based on cellular agriculture, resulting in products mimicking dairy in taste and protein content (Gandhi). Simultaneously, the food innovation of plant-based alternative is a growing niche that is increasingly gaining market share in the U.S. and encompasses a potential of reaping 40-50 percent of the market (Cooper A). In fact, a radical example of an incumbent dairy firm seizing the opportunity is Elmhurst Milked who, at the age of 93, reorganized their entire business model from traditional dairy milk into plant-based beverages based. This shift supports the assumption of the increasing transformation towards more sustainable business models in dairy (Garfield, 2017). Hence, innovations in dairy pose both a threat and an opportunity for actors within the upstream value chain. Nevertheless, regardless of the innovation type or the disruptive nature of it, changes within the U.S. dairy market are inevitable, leaving the impact of the industry value chain and its actors open for interpretation and analysis.

1.2 Problem Statement

The inevitable change within the dairy industry also raises the question of how existent players and new actors utilise this development. Thus, the motivation of this research is based on the driving force of environmental sustainability (Morelli, 2011) and the subsequent introduction of related innovations. As Goodland (1995) highlights, the three pillars of sustainability are interdependent. Thus, a rise in environmental sustainability likewise influences the economic and social dimension of an industry (Goodland, 1995). Consequently, this denotation initiated the discussion about the extent to which the traditional dairy industry, in particular the U.S., and the competitive position value chain actors is effected. Since the debate within the dairy industry is focused around alternative solutions of avoiding the common denominator of livestock (Russel, 2014) a need for investigating the most significant ones has been established. As the introduction and enforcement of innovation historically have had the ability to completely redesign conditions, a thorough analysis generalised with a specific industry is needed. Therefore, a comprehensive study of the development of environmental sustainability and its relation to both the introduction of new innovations in dairy and their impact on the U.S. dairy value chain is motivated.

With that said, a core dimension of the study circles around the theory of disruption and its impact on an industry value chain. Disruption is a widely used and sometimes even overly used concept in both an academic and non-academic context (Yu & Hang, 2010, Christensen, 2006; Charitou & Markides 2003). This dilution of interpretations has not only reduced the substance of the concept disruption but also lead to the characterising of events as disruption even though they may not be truly disruptive according to the original definition (Schmidt & Druehl, 2008). By identifying the degree of disruptiveness its implications for actors in the market can be evaluated in terms of the competitive advantage the innovation yields or the threat it portrays. Therefore, it is of interest to look into the disruptive impact of environmental sustainability innovations on the U.S. dairy value chain and how it affects value creation and competitive positions on the market.

1.3 Aim and Objectives

Consequently, the aim of this research is to identify how environmental sustainability innovations disrupt an industry value chain. This is done by utilizing the dairy industry as the center of this research. For this purpose, the U.S. dairy industry, in particular, is analysed in an empirical study to explore how environmental sustainability innovations disrupt the upstream value chain. This objective is met by analysing the type of innovation, its disruption potential as well as the business implications for actors within the value chain. Subsequently, the true disruptiveness of the given innovations is critically reflected upon. Thus, the study aspires to asses and add upon the theory of disruption and thereby aims to generalise the findings in a broader scope. Therefore, the given problem statement and research purpose lead to the formulation of the following research question, setting the focus of this study:

How do environmental sustainability innovations disrupt the dairy industry value chain and the actors within it?

1.4 Research Delimitations

The first delimitation of this study highlights that innovations chosen for this research are concentrated within the area of environmental sustainability and food technology, leaving out other macro trends that might affect the dairy value chain. Moreover, a delimitation of the value chain is applied in order to focus the research on the upstream instances characterised as Farming, Transport and Processing.

Another delimitation of this study is the focus on the U.S. market, which is identified as one of the leading actors in the food technology industry. Moreover, the delimitation to the U.S. dairy market entails a limitation to an inert market, constituting of traditional trajectories, values and policies. Furthermore, the U.S entails a delimitation to a developed country. However, the findings associated with these emerging challenges can be applied to any traditional industry, regardless of the country's state of development or the specification to the dairy industry.

The concept of Environmental Sustainability is acting as a background theory throughout the whole study and the literature review covers several theories and concepts regarding the same. Porter and Kramer's (2011) theory of Creating Shared Value encompasses an environmental as well as a social and economic perspective. However, this thesis will only utilise the first pillar of environmental sustainability for illustrating its impacts on the U.S. dairy value chain.

Referring to the data collection, the research process was focused on gathering information from various stakeholders within the dairy value chain. Thus, these stakeholders include Industry actors, Academia and Universities, Research Institutes and Non-profit organisations. The delimitations of stakeholders are set as an initial condition in which each group technically allowed for an unlimited number of interviewees.

Lastly, due to the business focus of the study, the research has been delimited to not incorporate the technicalities of the processes required or the specific alteration to machinery and procedures when analysing the strategic impact on the upstream actors. Thus, when analysing the impact of the two case innovations entail, a business perspective has been utilised.

1.5 Outline of the Thesis

First of all, an extensive literature review is provided with the intention to cover previous research in the area of disruption and incremental innovations in combination with environmental sustainability challenges altering value chains and current conditions. More specifically, the literature review is concluded with a conceptual model that is aiming to explain the connections and sequenced events between environmental sustainability innovations and its implications for the U.S dairy value chain. Thereafter, the method section clarifies the chosen research approach and methodological choices. Subsequently, the chapter covers the validity and reliability quality insurance of the study and thus provides the limitations of the same.

In addition to this, chapter five of the thesis consist of the analysis and discussion from the given empirical findings presented in chapter four. Here, empirical research is matched with theoretical reviews to provide multiple grounds to the upcoming conclusions for approaching the proposed research questions. The last chapter of the thesis is constituted of the concluding remarks where, as stated above, the research aim and objective are directly approached. This completed the study as it addresses the research question and presents the academic contribution in summary. Chapter six also includes subchapters for practical implications and the research limitations, leading up to a concluding section opting for future research founded on the above.

2 Literature Review

In this chapter, the overarching concept of Environmental Sustainability is reviewed in order to frame the research. Subsequently, the review deep dives into the interrelated concepts of creative destruction (Schumpeter 1942) and disruptive innovation (Christensen, 1997). In addition, incremental innovations as the opposing theory to disruption is reviewed (Rubin & Abramson, 2018). Furthermore, and connected to both incremental and disruptive innovations is the theory of the s-curve (Schilling, 2017), which acknowledges the lifecycle developments of innovations and companies. Lastly, the term industry value chain is examined and finally connected to all mentioned theories above. This connection is illustrated in the chapter summary in the form of a conceptual model.

2.1 Environmental Sustainability

The concept of environmental sustainability was firstly introduced by Goodland (1995), defining it as the maintenance of natural capital. The concept aims to improve human welfare by protecting both the source of raw material and the sink of human waste. The objective is to prevent harm to humans and to maintain sustainable production and consumption without compromising the health of the ecosystem that provides these resources (Morelli, 2011). For this purpose, Goodland (1995) divides environmental sustainability into two sides. The sink side of the concept refers to holding waste within a certain limit and capacity in order to avoid impacting the environment. On the other hand, the source side aims to maintain the harvest rates of (non)-renewables within regeneration rates. These regeneration rates can differ between countries in terms of output and input rates, however all focus on maintaining a certain environmental sustainability (Goodland, 1995). Thus, complementary to this, Morelli (2011) defines this as the balance between satisfying human needs without exceeding the ecological capacity in terms of diminishing biological diversity. Goodland (1995) further highlights the importance of integrating economic, environmental and social sustainability in order to create sustainable development. Thus, unlike other economic predecessors, he argues

that social and environmental value does not automatically exclude economic value, but instead requires an integrative approach to be successful (Goodland, 1995).

2.1.1 Creating Shared Value

Porter and Kramer (2011) define shared value as practices enhancing the competitiveness of a company, while simultaneously supporting both the economic and social environment in the industry they operate in. Thus, he combines societal and economic progress as one integrative approach to create a total pool of economic and social value. This resets the boundaries of capitalism and further contradicts with Friedman's (1970) concept in which the only responsibility of a firm is to maximize shareholders wealth and generating profit. Consequently, in the long run, improving value in one area will result in a rise of opportunities in others. Whereas Goodland (1995) specifically addresses the concept of environmentally sustainability, Porter and Kramer (2011) define value as a more general term that includes the sustainability approach. Therefore, both concepts address a similar issue, the creation of social value. Thus, the concept of shared value complements the environmental sustainability approach in terms of guiding a firm's strategic direction. By following an environmental sustainable business approach, one could assume that a firm is including the concept of shared value, creating economic as well as a social and environmental value relative to previous conditions (Porter and Kramer, 2011). Coming from this, it is stated that change is often driven in tandem with technological efficiency or development (Porter & Kramer, 2011). Thus, in order to allow a firm to incorporate environmental sustainability while also preserving competitive position, a firm needs to be on the lookout for innovations which could potentially alter the industry standard or the way it is structured (Porter & Kramer, 2011).

2.2 Disruptive Innovations

2.2.1 Creative Destruction

Schumpeter (1942) states that the general motor of society is the capitalistic system in which firms fuel changes in both goods as well as the production of them. Thus, this replacement through innovation-driven development is referred to as *creative destruction.* The term is

defined as the "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter 1942, p. 83). The notion of creative destruction also entails that these innovations liberate resources which can be utilised elsewhere, which will in terms of competitiveness create an efficiency rationale. According to Schumpeter (1934), the actor leading this development is the entrepreneur who creates new combinations of businesses. Schumpeter (1934, p. 66) refers to those combinations as: "The introduction of a new good; The introduction of a new method of production; The opening of a new market; The conquest of a new source of supply or raw materials; The carrying out of the new organization of any industry". As the primary purpose of creative destruction is to offer some form of substitute that is perceived as having better performance at a cheaper price, one particular form that enables creative destruction is disruptive innovations. Thus, the discontinuous change in the form of new technology or product is highlighted by examining the concept of technology s-curves below.

2.2.2 The S-Curve

Technology Diffussion and Consumper Adoption

According to Schilling (2017), a technological s-curve is referring to a technological trajectory, illustrating the rate of improvement to a specific technology or the rate of adoption, diffusing the technology on the market. This trajectory follows the s-shape of a curve, where the initial phases consist of smaller improvements increasing by time which at the latter phases decreases as the technology reaches its maturity. The relation between improvements and consumer adoption are considered as two-sided in which additional improvements to technology may yield a greater adoption by consumers, resulting in the economic motivation for further improvements. Therefore, the s-curve partly seeks to illustrate incremental improvements to an innovation or the gradual adoption by consumers to a new innovation. With that said, not all technologies live through an entire life cycle and are fully matured. Instead, the entry of new innovations, referred to as discontinuous technologies, interrupt the s-curve development and open space for new innovation making the old technology near to obsolete. Thus, these innovations fulfill a similar market need but utilise new knowledge or sets of capabilities to create new value. (Schilling, 2017). An example of this is the shift from chemical to digital photography, leaving the former in a vanished state similar to the effect of

creative destruction (Schumpeter, 1942). According to Rogers (1983), the consumer's role in adopting a new innovation or technology can be likened to a s-curve model, where the consumer is divided into different categories, depending on when the innovation is adopted. The model proposes five, normally distributed, stages of consumer adoption as the technology diffuses over time. These phases consist of Innovators, Early Adopters, Early Majority, Late Majority and Laggards. These stages emphasize that consumer awareness and acceptance for new innovations vary by consumer group but plays a vital role in innovations' market shares and its diffusion rates (Schilling, 2017).

Early Mover Advantage

Introducing change to an industry or reacting quickly to new opportunities is a strategy that is commonly utilised by actors in order to find alternate ways to generate profit. This is linked to the advantages associated with a first- and second mover, which is a common phenomenon for new innovations and discontinuous technologies. Lieberman and Montgomery (1990) state three ways to gain a first-mover advantage: A new product offering; A new process utilisation or the entering in a new market. According to Kerin, Varadarajan and Peterson (1992), a first-mover advantage is beneficial due to the long-term competitive advantage that is developed by having an in-depth involvement and knowledge about the innovation. Moreover, a first-mover can reap a higher market share compared to its followers by being directly associated with the offering, which a follower may not be. Thus, a first-mover obtains higher trust and a loyal base of adopters. In contrast, there are also negative aspects involved with being a first-mover if the market is not ready for new innovation. This subsequently supports the argumentation for being a late entrant or utilizing a second mover advantage (Schilling, 2017). Consequently, instead of arguing that a second mover solely responds to consumer demands one can argue that a later entrant can influence consumer attitudes (Schilling, 2017). In fact, the second mover can build on the first-mover knowledge and diminish its position by offering a higher value in terms of better product performance or a lower price. Consequently, the second mover may reap an even larger market share in the end (Kerin, Varadarajan & Peterson, 1992). Adhering to the concept of creative destruction, truly disruptive innovations may contribute to existing players being replaced by new actors. Coming from this, the term disruptive innovation and its implications will be elaborated below.

2.2.3 Defining Disruptive Innovations

For the purpose of this thesis, Christensen (1997) as the founder of the concept of disruption is firstly reviewed in order to introduce the initial thoughts of the theory. When reviewing the concept of disruptive innovation, it is essential to firstly differentiate between sustaining and disruptive technologies. Whereas sustaining technologies foster incrementally improved product performance, disruptive innovations entail new and different value creation. In contrast to sustaining innovations, which focuses on efficiency in current operations, disruptive innovations are focused on offering customers a cheaper, simpler, smaller or more convenient solution (Christensen, 1997). They emerge and progress in their home value network and only enter another network once they can satisfy the level of demanded performance. Therefore, disruptive innovations generally underperform established products in the mainstream markets but attract new and fringe customers. Eventually, as the name suggests, disruptive innovations disrupt the technology s-curve by offering new value technologies and subsequently outperform obsolete, established products in the market (Christensen, 1997).

With the above in mind, disruptive innovation is a broadly used term and concept in need for clarification when it comes to the impact it may entail on a market or industry. According to Govindarajan and Kopalle (2006), and complementing Christensen (1997), a product or service is considered a disruptive innovation if it is sold at a lower price and inferior in their characteristics and attributes compared to what mainstream customers value. Furthermore, a disruptive innovation must offer new forms of value propositions to the market in order to attract either new customer segments or price-sensitive markets. Lastly, disruptive innovation is also characterised by penetrating the market from niche to mainstream. Therefore, while Christensen's definition of disruptive innovation is rather bound to products or services that are cheaper, simpler or more convenient, Govindarajan and Kopalle (2006) define the concept more specific and thus will be used complementary to Christenen (1997) to distinguish disruptive innovations in this study.

2.2.4 Delimiting Disruptive Innovations

Due to the broad definition of disruptive innovation of Christensen’s (1997) initial work, a conflicting nature of the concept is detected. It is therefore crucial to state the distinctions

between different kinds of disruptive innovations, which Christensen and Raynor (2003) also later elaborated in "the innovator's solution". While disruptive innovations are broadly defined as products that first enter the market on the low end of an existing market, but then diffuse itself upwards, sub-groups of disruption distinguish itself from this term due to their different effects, firms, markets and competition. For this purpose, Markides (2005) suggests differentiating between technological, business-model and radical product innovations.

Business Model Innovation

The discovery of fundamentally different business models within an existing market is often referred to as business model innovation (Markides, 2005). This concept seeks to redefine existing products or services, such as the book, but changes specific attributes resulting for instance in a change of providing products and services differently to customers. Thus, the multinational company Amazon did not reinvent the concept of the book but changed its availability to the customers, thereby invading an existing market by offering different dimensions (Markides, 2005). Most importantly, by offering a new dimension of an existing market, new business models often attract different customer groups while simultaneously requiring different value-chains compared to the initial product or service. Thus, incumbent firms have in the beginning little incentives neither to adopt nor respond to this (Markides, 2005). Nevertheless, with the continuous growth of the new business models and the consequently improved performance on the technology s-curve, customers are increasingly responding to the new product and service and beginning to switch (Rogers, 1983). Consequently, bigger players are later attracted by the increasing growth and are increasingly responding to the disruptive innovation by copying it (Kerin, Varadarajan & Peterson, 1992).

Technological Innovations

While available literature suggests that business model innovations usually grow quickly to a certain percent of the market, but does not necessarily overtake traditional products and services, the theory suggests differently for disruptive technological innovations. In fact, Christensen and Raynor (2003) and Danneels (2004) argue that disruptive technological innovations will eventually dominate the market, even though they might have a respectively long process of reaching that point. Given that distinction between business-model and technological innovations, the general assumption is that the best ways to respond to disruptive innovations require an extreme approach of accepting and exploiting it (Markides,

2005). Hence, this differentiation highlights not only the different developments of a business model and technological innovation but also the dissimilar required reactions for established companies. Markides (2005) suggests to base decisions on a cost-benefit analysis and consider specific circumstances rather than immediately shifting to a new business model. Therefore, when comparing business model and technological innovation, the gravest distinction between the terms are their different effects on the market and thus their diverse adoption rate. This influences the way established companies should and could react to the uprising development of the market (Markides, 2005).

Radical Product Innovations

Another subcategory of disruptive innovations are radical products and services also referred to as new-to-the-world innovations (Markides, 2005). These are considered as radical since they are changing the way a consumer is perceiving current products by introducing products that interrupt the consumer's prevailing habits. Additionally, since new-to-the-world products are both disruptive for companies and consumers, these types of innovations are rarely driven by demand but instead by a supply-push (Markides & Geroski, 2005). While new entrants most likely introduce these radical type of innovations, they are not necessarily the ones who ultimately benefit from their own new-to-the-world products. Thus, due to strong efforts, such as investments and R&D in the early introduction of the radical innovations, late entrants benefit from an already improved performance of the given innovation at a later time of entrance. This is also referred to as a second mover advantage (Kerin, Varadarajan & Peterson, 1992). The equivalent high price also limits the attractiveness of the product for larger groups of the population and instead is more concentrated on technology enthusiasts and early adopters (Rogers, 1983). Thus, while obtaining a position of an early pioneer, researchers suggest to not underestimate the advantages of being a latecomer. Therefore, offering a product later that is good enough in performance, but cheaper compared to the initial innovation, is enough to attract a great share of consumers (Markides, 2005).

2.2.5 Elucidating Misconceptions of Disruption

When reviewing the concept of disruption, it is crucial to examine the concept from different lenses and thus straighten frequently occurring misunderstandings. As previously highlighted, disruption occurs in different stages and differs in its degree of actual 'disruptiveness'

(Markides, 2005). While this research already covered the necessary distinction between business-model, technological and radical innovations, it is also crucial to identify a scale to measure the disruptiveness of a certain product or service. Thus, a noteworthy contribution to this matter is Govindaraja and Kopalle's (2006) work on measuring the disruptiveness of innovations. In their research, they have identified a series of examinations that aimed to measure the reliability and validity of the disruptiveness scale and included, contrary to Christensen (1997), both high-end and low-end disruption. Thus, a suiting example in which a disruptive innovation initially launched as a high-priced item is the product innovation of the cellular phone. Despite its high price, the cellular phone was firstly adopted mainly by the business niche market, such as corporate executives. While the mainstream market initially rested upon the traditional landline phones due to cost, coverage and reliability, the gradual improvements of the technological aspects of the cellular phone lead to the mainstream market adopting the innovation, causing a disruption of the market (Yu & Hang, 2010).

Furthermore, it is important to note that disruption is a relative phenomenon, meaning that some innovation is perceived as disruptive for a specific firm, while the same innovation displays a sustaining business model for other firms (Christensen, 2006). This difference in perception is often not noticed, however very crucial when utilizing the term of disruption. Moreover, disruption does not necessarily imply an originating innovation from new entrepreneurs, but instead can origin from an incumbent firm. Furthermore, disruption neither entails that the entrants or businesses replace established businesses. Instead, it can have a major impact on the existing market without replacing incumbent actors on it (Schmidt & Druehl, 2008). As previously highlighted, incumbent firms can not only survive disruptive innovations but may also become market leaders or disruptors themselves, which is in line with the second-mover advantage previously discussed (Yu & Hang, 2010). Another noteworthy perspective is that while incumbent firms should respond to disruptive innovations in some way, it does not necessarily imply that a firm needs to adopt the innovation as Christensen (1997) suggests (Charitou & Markides, 2003). Thus, investing in their existing business in order to strengthen the traditional way of competing may thereby pose a bigger threat to entrants. Lastly, it is important to note that the concept of disruptive innovation does not equal destructive innovation (Yu & Hang, 2010). This entails that technological innovation with attributes of superior performance and low-cost structure, would indeed invade the mainstream market and have a higher destruction compared to 'normal' disruptive innovation that focuses on both low-cost structure and lower performance.

This indicates that the former is according to Christensen (1997), not a disruptive innovation, due to the higher performance, but undoubtedly has a higher destruction. As this misuse of the term disruptive innovation is relatively frequently occurring, Christensen himself stated that the term 'Christensen Effect' would have been a more distinct choice for avoiding the misinterpretation of disruptive innovation as radical or destructive innovation (Yu & Hang, 2010).

2.2.6 Predictive Use of Disruptive Innovations

Another highly debated area of disruptive innovations is its predictive use. While some authors argue that introducing an innovation that is disruptive is purely dependent on luck (Barney, 1997), other argue that disruptive innovation can be predicted or even enabled ex-ante (Daneels, 2004). These ex-ante predictions involve estimating what levels of supply certain technology innovations may be able to reach and include measures testing a market's ripeness for disruption (Schmidt, 2004). Schmidt (2004) model of predicting the ripeness of a market for disruption is built upon the idea of that if traditional product attributes are showing an overshoot, in the sense that many products have the same attributes, their secondary attributes are underserved. Thus, the introduction of a lower-cost product emphasizing secondary attributes at a lower cost and performance is then potentially successful. Furthermore, as the product begins to improve its performance gradually, it is expected to move up the market as a low-end disrupter.

Another form of forecasting disruptive innovation is based upon Govindarajan and Kopalle (2006) that introduced a framework in which a firm's likelihood of developing a potentially disruptive innovation is displayed. They suggest that if Firm A has a higher willingness to cannibalize than Firm B, then Firm A is more likely to develop disruptive innovation compared to Firm B. Nevertheless, one crucial issue when predicting a potentially disruptive innovation is to identify the future drivers, meaning to analyse when old drivers reach their limit and new drivers, changing the customer's environment, arrive. Therefore, the act of predicting a disruptive innovation is respectively vague and not certain (Yu & Hang, 2010).

2.3 Incremental Innovations

Another item that is considered to foster change is the concept of incremental innovation. Thus, a shift within the industry can not only occur by introducing a new product or process but also by improving an existing version of an offering (Rubin & Abramson, 2018). Thus, it is essential to not bypass the opportunity for gradual improvements by incrementally enhancing innovations in order to maintain a competitive position. Moreover, responding to an external alteration of market conditions is seen as a rationale for innovation (Rubin & Abramson, 2018). Using innovation to fuel change is a well-known phenomenon, however not every change represents an innovative development. According to Asch and Rosin (2015), innovations encompass the "testing and translation of ideas into value-generating solutions, by new products, services, or systems". Thus, incremental innovations are referred to as sustaining innovations, where additional enhancements improve existing offerings, processes or services, while still preserving the core operations of a firm (Varadarajan, 2009; Rubin & Abramson, 2018). In addition, improvements in existing technologies are also referred to as incremental innovations (Ghosh, Kato & Morita, 2017). With that said, the process through which incremental innovations create value follows a course of actions that can be seen as a stage-gate process where development reflects a linear system (Rubin & Abramson, 2018). Incremental innovation can be applied on both product and process innovations, where the former aims to reduce the substitutability of the offer, whilst the latter focuses on reducing the unit marginal costs (Lin & Saggi, 2002; Rosenkranz, 2003).

2.3.1 Inadequancies of Incremental Innovations

Despite the advantage of business resilience, situations exist in which additional improvements are not sufficient to prolong life cycles or compete in the marketplace. According to Leonard and Rayport (1997) firms should consider a more radical business strategy when an increase in sales from a cost reduction is not met or when the success rate from an incremental innovation investment is below the predictions. This will require a course of actions that alters the existing business significantly in order to reap further market share or move into an entirely new industry. Tushman (1997) states that incremental innovations need to be accompanied with disruptive changes since every market will reach a maximum of a product life cycle, which is similar to the maturity of a technology's s-curve (Schilling, 2017).

This motivates a shift fuelled by disruptive innovations in order to alter existing and concurrent industry conditions.

2.3.2 Imitation Strategy to Innovations

Competition from between new innovations and established products are frequently existent in many markets. Adopting an imitation strategy to compete with new industry entrants and their innovations is considered to reduce both the risk and uncertainty traditionally associated with novel disruptive innovations (Bikhchandani, Hirshleifer & Welch, 1998). Furthermore, an imitation strategy reduces searching costs for resources or capabilities as well as enhances the actual legitimacy of the innovations since multiple players have adopted it (DiMaggio & Powell 1983; Katz & Shapiro, 1985). Deploying imitation as a strategy is similar to deploying incremental innovations since once the innovation is imitated it is perceived as a safer innovation compared to its initial phase of introduction. Thus, an imitation strategy is connected to the second mover advantages (Wu, Harrigan, Ang & Wu, 2019; Schilling, 2017).

2.4 Industry Value Chains

Kaplinsky (2004) portrays a value chain as "the full range of activities that are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and final disposal after use". This definition roots from the two descriptive structures of a value chain given by Porter (1985), dividing it into the process of supply and the support services for the product. Furthermore, this view has been complemented by the scholar himself to the extension of a value system, including interindustry linkages to the given concept. An industry value chain in comparison to an internal value chain describes the characteristics of a chain that is general to the activities performed by a whole industry. Those instances of a value chain are thereby not firm-specific, and thus allows for a broader comparison and generalisation of industries. Moreover, an internal value chain involves a range of activities within each instance of an industry value chain and is therefore included in a value chain analysis (Kaplinsky, 2004).

2.4.1 Disruptive and Incremental Innovations in Industry Value Chains

Respecting the two major concepts of disruptive innovations and industry value chains it is crucial to combine these notions in order to recognise their relation and comprehend the effects disruptive innovations have on an industry value chain. According to Kaplinsky (2004), a value chain analysis partly consists of the introduction of new combinations which yield economic rent and prosperity, however, can lead to an uneven resource trade-off. As stated by Schumpeter (1942), scarcity can be a subject to construction arising as a consequence of deliberate behaviour or the introduction of a new innovative product. As mentioned previously, the entrepreneur possesses a key role in the introduction of new combinations, hence also the development of the society and thereby the changes to an existing value chain. Following the launch of a new innovation, the entrepreneur can reap a surplus, an economic rent, exceeding the cost of the introduction (Schumpeter, 1942). This is similar to the diminishing rate of return coming from the introduction of a new technology, as illustrated by the technology s-curve (Christensen, 1997). Such a process motivates new combinations and the development of a market or value chain.

Incremental innovations in an industry value chain involve constant improvements, where process innovation often encourage managing waste or solving inefficient operations in order to optimize businesses. From an industry value chain perspective, this could occur in any instance of a chain, enabling a competitive advantage. (Benner & Tushman, 2002). Looking to a cooperative perspective, scholars have emphasized that transparency through the sharing of processes to suppliers or customers can bring with learning, thus develop capabilities for continuous improvement and result in more efficient operations (Soosay, Hyland & Ferrer, 2008). Kaplinsky (2004) also identified efficiency as a vital component of a value chain analysis. This perspective adds a systematic analysis of the value chain, by assessing the efficiency of each instance and the cooperation between steps in the chain. The aspect of efficiency has been widely adopted into operations, generally referred to as supply chain management for the enhancements throughout the value chain. On a firm level, a focus is centered around the agency of new product and innovation developments (Morgan & Monczka, 1995; Ragatz, Handfield & Scannell, 1997).

2.5 Disruptive Environmental Sustainability in Industry Value Chains

The notion of creative destruction has been deployed in the field of environmental sustainability and innovative solutions to meet the challenges ahead. Hart and Milstein (1999) further progressed this phenomenon into the concerns of global sustainability and the destruction of industries. Thus, innovation is divided into two sections, continuous improvements and radical transformations also referred to as creative destruction. Continuous improvements, i.e Greening, entails rationalizing the existing industry with incremental improvements, while creative destruction in terms of sustainability entails a transformation of the industry structure. The idea of altering industries can be implemented on the micro level in terms of disrupting value chains. Nidumolu, Prahalad and Rangaswami (2009) framed sustainability as the key driver for innovation and state that a realization of this will enhance businesses significantly. Among others, two phases are mentioned as key for this change: Making value chains sustainable and designing sustainable products and services. The former incorporates both incremental innovations such as reducing waste, but also the more radical notion of using other raw materials or redesigning the supply chain. The latter is connected to consumer insights and the benefits of moving before or along with emerging trends, such as environmental sustainability and food technology. This again is connected to the consumer adoption of new innovations, illustrated by the s-curve (Schilling, 2017).

2.5.1 Strategic Implications

Following sustainable business creation, Fiksel (2017) addresses sustainable enterprise resilience with the aim of creating opportunities through the use of green technologies, implying a reduction in energy use, raw material and resources. Besides this, a more transformational approach to business strategies is also identified by using innovative solutions to reuse waste through the introduction of new resources or processes. With that said, Fiksel (2017) states that the era of incremental innovation through subsequent changes has passed. The significant transformation needed to offset the negative environmental spiral is not sufficiently met with incremental adjustments. Moore and Manring (2009) acknowledge the same and discuss that the optimum business type to tackle disruptive environmental changes is the entrepreneurial inspired SMEs, Small-Medium Enterprises. This, since SMEs

have organizational flexibility and efficiency, in comparison to a large and bureaucratic MNC, Multinational Corporation. MNCs tend to uphold barriers to change along with an organizational inertia. Thus, making Schumpeter's term, creative destruction, applicable here as well (Schumpeter, 1942). The SMEs have proven to thrive in such an accelerating marketplace, whilst the incumbent MNC has struggled in taking full use of, or creating, new innovative technologies, processes or raw resources for establishing a competitive position. In addition, Senge, Smith, Kruschwitz, Laur and Schley (2008) states that "small firm innovation advantage" is likely to take place at the early phase of a life cycle in industries where large corporations encompass a high market share.

Moore and Manring (2009) propose that SMEs have the opportunity to create transformational change in line with a business advantage, instead of simply "reducing unsustainability" as Fiksel (2017) phrases it. Consequently, this entails opportunities for a strategic competitive advantage for SMEs, such as a rapidly changing marketplace along with expanded and strong-linked supply chains (Seuring & Muller, 2008; Moore & Manring, 2009). Furthermore, disruptive changes fuel accelerating cycles of innovation which can be linked to the technological s-curve and the replacement of incumbent products by new entrants (Schilling, 2017; Schumpeter, 1942). Besides the destruction of incumbent businesses as a consequence, Moore and Manring (2009) propose a scenario where there is room in the value chain for both SMEs and MNCs, based on their complementary nature. Whereas the SMEs constitute an engine for sustainable innovations, the MNCs integrates the necessary resources, such as financing and established infrastructure, to foster the development in the market. Furthermore, as Porter and van der Linde (1995) highlight, a competitive advantage can be created by utilizing a combination of technology innovation and incremental costly improvements by reducing waste in order to reach economies of scale. Thus, enabling a marketplace where all actors thrive and develop jointly from a collaborative nature to create even higher value at last (Porter & van der Linde, 1995).

2.6 Chapter Summary

For the purpose of this research, theories connected to the broad macro trend of *environmental sustainability* are used as a substantive guidance in creating a theoretical rationale for later analysing the impact on the dairy value chain. Furthermore, the formal theories of *disruptive innovation* and *incremental innovation* were individually reviewed and followed by a synthesis of how and why *these innovations impact an industry value chain.* Thus, as Schumpeter (1934; 1942) and Christensen (1997) state, the introduction of new combinations result in changes to an existing value chain, extending the theory of disruption on a market into the consumer adoption yielding a high market share (Schilling, 2017; Rogers, 1983). Lastly, the concept of environmental sustainability was combined with the previously introduced formal theory of *disruption in industry value chains* to delimit the thesis by opting for large or small changes (Kaplinsky, 2004; Fiksel, 2017; Moore & Manring, 2009). This synthesised formal literature and the concurrent substantive theory is visualized in the conceptual model below.

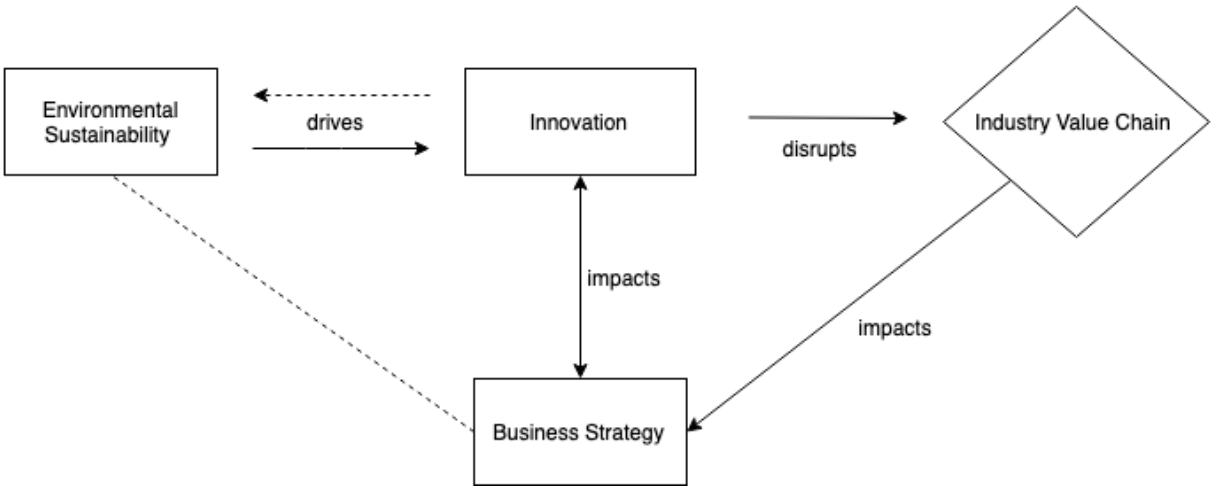

Figure 1: Conceptual Model

Firstly, Environmental Sustainability and its relation to Innovations is highlighted. As previously mentioned literature emphasises the relation of environmental sustainability driving the creation of innovations, however only slightly acknowledge the case of innovation driving environmental sustainability. Nevertheless, a mutual connection between the two is endorsed and this differing emphasis of authors is visualized by the dissimilar arrows.

Furthermore, in line with the research objective, a cause and effect relationship is examined between the concepts of Environmental Sustainability, Innovation and Industry Value Chain. It is important to note that the industry value chain is the dependent variable in this conceptual model while the other two are mutually connected dynamic forces impacting the former. Consequently, the effects on the dependent variable, industry value chain, also affect actors and their business strategy, which is visualised with the arrow below it.

Secondly, the relationship between Innovation and Business Strategy is highlighted. In this model, the relationship is portrayed as a mutual connection, where the radicalness of the business strategy influences the choice of innovation, and the radicalness of the innovation corresponds to the business strategy of being an early adopter or late entrant. Thus, their relation involves the theory of early- or second mover advantage (Kerin, Varadarajan & Peterson, 1992; Rogers, 1983). In this conceptual model, a first-mover advantage resembles a radical business strategy aiming to develop new innovations with the aim to disrupt the market (Lieberman & Montgomery, 1990; Christensen, 1997). In contrast to this, utilizing a second mover advantage coincides with the adoption of an already existing innovation and consequently results in innovations with a low disruption potential (Kerin, Varadarajan & Peterson, 1992; Wu et al., 2019).

Lastly, the relation between Environmental Sustainability and Business Strategy is acknowledged. Indeed, global environmental sustainability challenges, as mentioned in the background chapter, contribute to the discussion of the responsibility of a for-profit firm making the relationship between those concepts evident (Chandler, 2017). Nevertheless, since the conducted study does not focus on corporate social responsibility, the relationship between Environmental Sustainability and Business Strategy is not highlighted in the analysis.

3 Methodology

In this chapter, the research approach, as well as the chosen research design for the study are presented. This is followed by a description of the utilised empirical data sources and the method of collecting data. Lastly, a section concerning the method for the data analysis is presented ending in a discussion about the quality of the study constituting of validity and reliability strategies as well as limitations of the chosen research approach and design.

3.1 Research Approach

The appropriate research approach has for long been commanded by two ends of the spectra, deductive or inductive research. As stated in Bryman and Bell (2015), a deductive approach roots from theory with the aim of testing the established ones, whilst the inductive approach springs from empirical research in order to instead build theory. As neither one alone seems to fit the needs of this research, a third approach is considered, constituting of a combination. This approach is referred to as an abductive approach, which combines strengths as well as answers to weaknesses of the respective approach (Alvesson & Sköldberg, 2009). This is combined with an iterative process, enabling the researchers to move back and forth in their research to deliver accurate results (Bryman & Bell, 2015).

Accordingly, the methodological design follows an abductive approach (Cresswell & Cresswell, 2018). Hence, the research firstly commenced with a deductive focus while reviewing relevant theory. However, once empirical data collection has begun, this shifted the focus of the study into an inductive approach. When analysing the material, this method partly consisted of testing relevant theories, but the data collected, which could neither be explained nor linked to existing theory, was approached with inductive reasoning. To continue, the study took on an iterative design (Cresswell & Cresswell, 2018), where the initial plan was both added and altered within the process of the research.

Eisenhardt (1989) states that inductive research encompasses an iterative process where data collection and data analysis are overlapped with one another. By being responsive, adaptive and on the verge of opportunistic in the data collection, the researcher can direct the study towards the chosen research rationale. This approach was adhered to in this research, by introducing data collection in the beginning weeks of the thesis process. The collected data was gradually and constantly analysed throughout the process, enabling the iterative research approach. This also contributed to the inductive character of the research by influencing the continuation of the data collection.

3.2 Research Design

This study follows a qualitative method by collecting empirical data through expert interviews. Furthermore, a multiple case study approach is utilised consisting of two cases, Plant-Based Innovation and Cellular Agriculture Innovation, where the common unit of analysis is the Innovation in the U.S Dairy industry. Moreover, the research has a holistic view on the unit of analysis, since the innovations as a whole are considered, instead of only sub-units within these (Saunders, Lewis, & Thornhill, 2015). According to Bryman and Bell (2015), qualitative research is best used when the subject of a study encompasses changing social contexts. Furthermore, the multiple case study is used to examine similarities and differences between the two innovations in the dairy industry in order to highlight generalisations, uniqueness or patterns (Santos & Eisenhardt, 2004; Saunders, Lewis & Thornhill, 2015).

Consequently, this approach allows the study to have an enriched depth in which complementary aspects of the studied phenomenon were collected (Yin, 2014). Moreover, Lee (1999) states that qualitative research is conducted correctly when it is contextually based on the aim of interpreting complex processes, for example not only outcomes but also the means of reaching it. Such a view is adhered to in this thesis since the research objective is to explore and understand how the U.S. dairy value chain and the players in it are affected by environmental sustainability innovations. Therefore, understanding the processes, events and contexts from which this occurs was essential when addressing the research question (Pettigrew, 2012).

3.2.1 Defining the Case Study

As Thomas (2011) suggests, a case study consists of two elements, a subject and an object. In this case, the subject itself are the innovations, explored through a multiple case study of plant-based and cellular agriculture. The case objects are the theories of disruptive and incremental innovation along with competitive implications they yield. The case study method has been used by numerous qualitative scholars (Pettigrew, 2012) to either provide a description, test or generate theory (Kidder, 1982; Anderson, 1983; Pinfield, 1986; Harris & Sutton, 1986). The research design of conducting a multiple case study encompasses the use of analytical generalisation aiming to link the cases to the theory (Schwandt, 2007). The rationale for this multiple case study was to both test theory deductively as well as aspire to inductively generate new contributions to the existing one. The abductive research approach entails the joint utilisation of explanatory and exploratory approaches. The exploratory note is adopted when heading out in the field, exploring, collecting and identifying data. Whereas the explanatory perspectives of the case study are used in order to assess why and how events are occurring. The explanatory elements do not only follow a deductive pattern matching to existing theory but also incorporates inductive reasoning when empirical data cannot be explained by the theory at hand (Yin, 1981).

Furthermore, to develop theory through case studies, it is essential to clearly define the research question for direction and delimitation (Eisenhardt, 1989). The definition of the prevailing research question for this study was partly derived from the creation of distinctive aim and objectives, leading into a section covering the research delimitations. The research question also sprung from a practical and theoretical motivation, representing the focus of the study (Eisenhardt & Graebner, 2007).

Choosing Cases

The different innovations within the U.S. Dairy Industry were acknowledged and identified at the start of the research process, where both plant-based alternatives and radical food technology innovations were repeatedly mentioned in secondary sources. Consequently, two innovations were recognised before starting the empirical data collection, and during the process, it became apparent that the interviewees emphasized these as well. Therefore, the motivation for the multiple case study of the two innovations emerged, and a narrowed focus within the subsequent interviews was set on specific information regarding these two cases.

Whilst the relativity or existence of disruptive innovations may vary between the identified cases, environmental sustainability is considered to be a cross-case similarity. Therefore, the study's unit of analysis, innovations, was the leading factor when formulating and revising the research question.

3.3 Data Collection Method

3.3.1 Literature Review

As a method for collecting material for the literature review, the information search was conducted through the utilisation of databases accessed through Lund University. The search was mostly concentrated on LUBsearch, Business Source Complete as well as Google Scholar. This was accompanied by the use of systematic search words such as:

AND/OR ENVIRONMENTAL SUSTAINABILITY
AND/OR DISRUPTIVE INNOVATIONS
AND/OR INCREMENTAL INNOVATIONS

Furthermore, the literature review was extended and complemented through the use of snowball sampling, where bibliographies were utilised to, in a systematic manner, guide the material search further. This referral enabled a richer collection of sources to create the literature review, as well as assured a chain selection to a specific population of scholars. However, the downside of such sampling may be the narrowing of fields and opinion biases (Biernacki & Waldorf, 1981). With that said, the literature review is targeted to specific concepts and theories, entailing that the narrowing of the search field may be to an advantage.

3.3.2 Data Sources

The sampling strategy for the study followed the use of multiple sources of data, which is in line with the general characteristic of a qualitative study. Moreover, multiple sources of data are referred to as triangulation of data, which was realised through the combination of interviews with secondary data analysis (Cresswell & Cresswell, 2018). Furthermore, the use of different levels and units of analysis support the use of triangulation in terms of

incorporating several perspectives. These were used as data sources to receive broad and objective accounts on the implications for the U.S. dairy value chain. This implied meeting with different levels of actors in connection to the US dairy industry, who all presented an expert view in their own field.

The participants were purposefully selected to enable a holistic account for the study (Cresswell & Cresswell, 2018). The sampling method for identifying as well as establishing contact with interviewees firstly followed a method of purposive sampling. This is appropriate when studying a certain field of experts, thus allowing the right interview subjects to be found (Dolores & Tongco, 2007). The sample was located by a general industry search on the internet as well as through the use of the career network platform LinkedIn. Secondly, the method of convenience sampling was applied, since the ability to contact the subjects in question was restricted. Once a few contacts were established this enabled a snowball sampling where a chain of referrals was provided, facilitating a connection to hard-to-reach populations (Biernacki & Waldorf, 1981). This method allowed for a larger group of interviewees to be established, thus enriching the size of the multiple case study as well as the collected material. The possible negative implications from the use of convenience- and snowball sampling are that the holistic account of interviewees may be restricted when chain referrals drive the study sample. (Biernacki & Waldorf, 1981). However, since the study sample consisted of different stakeholder groups to the U.S dairy value chain, the field restriction argument cannot be fully applied. In practical terms, these participants ranged from stakeholder groups, that all are representative sources due to leading in the field or leading in knowledge.

3.3.3 Interview Overview

It is important to note that the interviewee's contribution to this thesis was critically reflected upon and not explicitly taken as theoretically correct for evaluating the implications for the U.S. dairy value chain. Furthermore, it is acknowledged that the term disruption needs to be carefully handled as it is a misused concept as previously highlighted in the Literature Review. Thus, when practitioners utilise the word disruption the study does not automatically accept their individual definition, but instead only acknowledges that the term is used to explain a certain change within the industry.

Number	Name	Stakeholder group	Field of Expertise	Date	Time
1	Perumal Gandhi	Co-Founder of Perfect Day	**Cellular Agriculture**	29.03.19, 18:00	35 Minutes
2	Pete Pearson	Senior Director, Food Loss and Waste at WWF	**Plant-Based Alternative** (Cellular Agriculture)	03.04.19, 17:00	55 minutes
3	Mark Cooper (A)	Geographer & social scientist focused on climate change, agriculture, and the environment	**Cellular Agriculture, Plant-Based Alternative**	05.04.19, 18:00	47 Minutes
4	Tobias Linné	Course leader for the course Critical Animals Studies, Animals in Society, Culture and the Media.	**Plant-Based Alternative**	11.04.19, 10:00	49 Minutes
5	Kate Krueger	Research Director New Harvest	**Cellular Agriculture**	16.04.19, 15:30	33 Minutes
6	Ludwig Bengtsson Sonesson	Communication officer Centre for Environmental and Climate Research (CEC)	**Plant-Based Alternative** (Cellular Agriculture)	24.04.19 14:00	52 Minutes
7	Shashank Gaur	Vice President of Innovation at Elmhurst Milked, LLC	**Plant-Based Alternative** (Cellular Agriculture)	25.04.19 17:30	56 Minutes
8	Mark Cooper (B)	Geographer & social scientist focused on climate change, agriculture, and the environment	**Plant-Based Alternative, Cellular Agriculture**	06.05.19 18:30 (follow up)	32 Minutes
9	Todd Hutson	Managing Director at Tetra Pak Filtration Solutions	**Plant-Based Alternative Cellular Agriculture**	08.05.19 17:00	55 Minutes

10	Lloyd Metzger	Professor and Alfred Chair in Dairy Education & Director Midwest Dairy Foods Research Center South Dakota State University	**Dairy Industry** (Cellular Agriculture) (Plant-Based Alternative)	17.05.19 15:30	26 Minutes

Table 1: List of Interviewees

*()= Mentioned, but no strong focus

3.3.4 Data Collection

Primary Data Collection

The primary data collection was derived from expert interviews with a semi-structured design, consisting of a 30-60 min video conference. These were based on an interview guide created both from secondary data as well as the utilised and chosen theories, resulting in questions focused on collectively addressing the research question (Cresswell & Cresswell, 2018). Since the aim of the research was to gather expert insight in the same research topic and case subject, a basic interview for concurrent questions and areas was created, which was used in all interviews. This guide was uniquely modified for each interviewee in terms of field-specific questions depending on the respondent's formal area of expertise (Appendix A). Nevertheless, all interviewees were asked to comment on innovations in the dairy industry and the impact it has yielded, regardless of their personal expertise, to gather a fuller stakeholder view. Therefore, each interview was customised to adhere to field expertise, however only to a limited degree in order to allow the triangulation of the two cases and the empirical findings.

The interviews were recorded with consent and later transcribed. For this purpose, a winnowing method was utilised, meaning that the transcription for example did not include the introduction and ending of the recording. After listening and evaluating material, important and valuable sections were transcribed carefully using a software called Otter.ai for processing, followed by manual transcription for correcting sentences (Guest, MacQueen & Namey, 2012). The transcriptions were created within one or two working days after the initial interview, in order to gather insights for further data collection, as well as to indirectly

start processing data and discussing among the thesis writers. Thereof, the iterative research design of this study was adhered to through a joint method of data collection and analysis to grasp each case separately and together (Eisenhardt, 1989). Insights given from previous interviews were also used in formulating questions for later ones, making the semi-structured interview guide more complex towards the end. This development corresponded both with the iterative research design, as well as the researchers learning, data processing and insights throughout the course of the empirical study.

Secondary Data Collection

The secondary data collection was derived from academic reports, -journals and news articles. The utilisation of secondary data was first to put the topic into context. For this reason, the historical development of the US dairy industry, including trends was systematically researched. Here, only reliable, country-specific sources such as United States Department of Agriculture, United Nations, Industry related Companies, World Wildlife Fund, and other dairy-related foundations were utilised to analyse facts, trends and other country-specific factors. It was ensured that all data is up-to-date in order to support the validity of this research. As mentioned above, the secondary data also functioned as material for interview guides and understanding of the background, as well as a foundation and frame for the coming analysis.

3.4 Data Analysis

As mentioned, the research design followed the method of a multiple case study, in which two cases were identified and analysed, where the unit of analysis, Innovations, portrayed a common denominator. The interviews with two industry actors, Perfect Day and Elmhurst Milked, were utilised as within-case company examples and were focused on the two identified Innovations in the dairy industry. Therefore, the other interviews with academia, non-profit organisations and research institutes were utilised for legitimacy of information for both the two cases in general, but also for commenting on the company examples in order to either be supportive or contradictory.

The transcribed data was used as a foundation for the analysis. Valuable content was outlined and later grouped to identify similarities and differences, using a coding program named Atlas TI (Appendix B). Coding the data into brackets gave room for a categorization, enabling a thematic analysis. The initial categories were created from codes that occurred repeatedly in the material, were explicitly stated as important by the interviewee, resembled results published by other scholars or current theories. The thematic findings were put into joint larger categories, taking root from the research question, the available literature, theories and concepts at hand (Cresswell & Cresswell, 2018).

The identified group codes and categories, including the two cases along with respective company examples, were lined up in systematic order and presented with corresponding interviewees in the empirical data section. Hence, firstly an introduction to the U.S. Dairy Industry was presented in order to provide an appropriate background. This was followed by Case 1: Plant-Based Innovation, divided into the type of innovation and the disruptive potential it holds, further illustrated by a company example in the name of Elmhurst Milked. The same structure was used for Case 2: Cellular Agriculture Innovation also constituted of a company example; Perfect Day Foods. This was concluded with an implication chapter for the effects for both actors as well as upstream instances of the industry value chain. In the last subchapter of the empirical findings, a concluding illustration constituting of a summary table was drawn out in order to enable a clear view of the identified empirical themes.

The data analysis was motivated with Yin's (2014) method of pattern matching to deductively test theory by categorizing findings using the same terms as previous literature has done. For the two cases, a within-case- as well as cross-case analysis using the conceptual model constructed in chapter 2.6 was used. The cases were firstly assessed through Christensen (1997) definition of disruption and later categorized within the Markides Typology (2005). The use of the typology resonated with and gave legitimacy to the problematized discussion about the disruptiveness of innovations as well as the elucidating misconceptions in regard to Christensen's theory (1997). Lastly, the impact on upstream players in the value chain was assessed. Furthermore, the abductive research approach allowed for an inductive explanatory perspective on the material that did not fit theory according to the pattern matching method in order to address the research question fully.

3.5 Quality of the Study

3.5.1 Limitations of Qualitative Multiple Case Studies

Despite the various advantages of a qualitative case study, there are also limitations. Easterby-Smith, Thorpe and Jackson (2015) emphasise the difficulties for analysing data. This argument is based on the requirements of interpretation, which in itself is coloured from tacit knowledge of a researcher. In this research, a subjective note is required in order to steer the development of the study towards the research rationale (Eisenhardt, 1989). Hence, the priority of this research was being transparent and realistic while conducting the data.

Another common argument opposing case studies is the generalisability of findings and results (Yin, 2014). However, this debate is covered with the previously indicated aim of providing analytical generalisation and not statistical probabilities (Yin, 2014; Schwandt, 2007). The third opposition towards qualitative research is the time aspect, especially in the data collection phase which in the end could badly affect the outcomes of the study (Easterby-Smith, Thorpe & Jackson, 2015). In order to have a systematic and focused data collection within the study's time frame of ten consecutive weeks, the researchers chose the delimitation to one specific industry, the dairy industry, as well as one specific country, the United States. The choice of a multiple case study, may be contradicting to the time argument, however, the two cases are limited to one respective innovation and are addressing a larger case subjective. Thus, a multiple case study is appropriate as a rationale for structure and clarity. Lastly, in order to ease the data collection process, the case country was not visited, but instead, data was collected virtually.

3.5.2 Validity and Reliability

When discussing validity and reliability in a qualitative study, one needs to distinguish between their different meanings. Validity is referred to the accuracy of the study and its findings by deploying several strategies to prove it, while reliability entails the consistency of the research design and execution in comparison to other studies and scholars (Cresswell & Cresswell, 2018).

Validity

According to Yin (2014), the validity of a study can be divided into two parts, internal and external. Thereof, high internal validity refers to clearly explaining the causal relationship between the independant and dependant variables, as well as how well the research has been conducted in discharging the impact of other variables (Yin, 2014). In general, internal validity is higher for a qualitative study compared to external validity, since the aim is to explain a causal model of relations through empirical findings (Bryman & Bell, 2015). For this research, the internal validity is perceived as fairly high, since the causal relationship between the independent and dependent variables, Environmental Sustainability/Innovation and the Value Chain, have been confirmed by several primary, as well as secondary sources. The use of multiple primary sources, in the form of semi-structured interviews with ten unique respondents, along with secondary sources have allowed for triangulation of data, thus supporting a higher internal validity and analytical generalisation (Schwandt, 2007).

Furthermore, the validity of this study is founded on the very notion of the type of sources, basing all interviews on expert predictions. However, what can be noted and criticized is the selection of these experts. This was performed in an objective manner due to the lack of personal ties between the researchers and the interview objects, as well as the geographical distance making previous interactions more difficult and unlikely. In addition, presenting a rich narrative description of findings in the analysis as well as acknowledging any personal bias from the researchers can be seen as other strategies for proving accuracy (Cresswell & Cresswell, 2018). The former is used when presenting the data analysis, as is the latter present in the concluding discussion of the thesis.

Reliability

Referring to Selltiz, Wrightsman and Cook (1976), high reliability in research entails the consistency and stability as well as the ability to repeat the study. Reliability can be fostered by documenting processes, allowing others to have insights into the documents and guides used to proceed with the research as well as using well-established collection and analysis methods. (Cresswell & Cresswell, 2018). A significant data display is also important in order to conduct theory testing against existing literature. The reliability of the study is proven by a repeated control of transcripts and the categorization of codes and themes. Moreover, the utilised interview protocols were shared in the appendices, as was the full transcription shared with the supervisor in question. Furthermore, conducting a reliable study was attempted

through the use of the well-known deductive analyse tool for qualitative studies which was developed by Yin (2014) and has been used by many scholars since then.

4 Empirical Findings

In this chapter, the secondary data for the U.S. dairy industry will be firstly reviewed in combination with primary data concentrated around the dairy industry in order to create an overview of and an introduction to the industry changes. Subsequently, the chapter will continue with presenting, reviewing and objectively evaluating the empirical findings from the conducted interviews. The empirical findings are presented by focusing on the two cases of plant-based innovation and cellular agriculture innovation and will be examined in that order.

4.1 Introduction to the U.S. Dairy Industry

Dairy is a traditional established product that has been a widely used source of nutrition for decades in the U.S. (Cooper). With the modernisation of agriculture, a shift from low-value markets to high-value markets in terms of improved processes, structures and best practices occurred. Moreover, the same process changes and large-scale production has been identified in the Western countries (De Haen, Stamoulis, Shetty & Pingali, 2003). Such industry production of agriculture comes with global critique since the scale economies generates concerns for food safety, animal welfare and environmental damages from unsustainable water and land use. Furthermore, the exponential growth of large factory farms is done at the expense of small, household farmers who are being pushed out of the market (Pingali, 2007).

4.1.1 U.S. Food Value Chain

Moving to the US food supply chain, Maloni and Brown (2006) indicate that it consists of a complex sequence of activities varying depending on the specific product in question, as well as market and players active within it. Nevertheless, food originating from plants or livestock, both root from farming thereby representing a shared initial instance. The next step in the value chain

generally entails a farmer selling their raw resources to a food processor through a path of transportation. However, the farmer may also have a direct channel to distributors or retailers and even consumers. Nevertheless, going via a processing firm encompasses the next instance of selling to a distributor, however, larger processors may sell directly to retailers and consumers. No matter the pathway, such activity adds a step of distributing the processed product through the transport to retailing before reaching the final customer (Maloni & Brown, 2006). When setting a focus on the dairy industry, environmental sustainability challenges are inevitable. Moreover, the discussion often circulates around a large carbon footprint due to a hefty dependence on non-renewable resources, which per definition is an unsustainable process, in need for a reduction of waste throughout the food system (Charles, Godfray & Garnett, 2014). Furthermore, von Keyserlingk, Martin, Kebreab & Knowlton (2013) state that there are unsustainable practices in the dairy industry, most evident in the farming instance of a value chain where petroleum often is use for planting, fertilizing and harvesting crops, as well as producing feed to the livestock.

4.1.2 Dairy Industry and its Fixation

As an ingredient, dairy is not only produced for the pure consumption of liquid milk but also utilised for the production of by-products such as cheese and yoghurt (Cooper A). Despite this, all interviewees in this study agree that liquid dairy consumption has declined in the past two decades and will continue to decline in the future. While liquid dairy products are decreasing in demand, "plant-based alternatives are taking increasingly larger share" (Linné). Nevertheless, it is important to note that while there is a decline for liquid milk, the by-products such as cheese and yoghurt are remaining in the status quo (Gandhi; Cooper A). This is on the one hand due to the inability of dairy alternatives to recreate the taste, and on the other hand due to the development of milk increasingly becoming a by-product itself (Gaur). Since both companies' and consumers' awareness regarding sustainability are growing, the question of dairy's position within this development arises (Krueger).

As a traditional, natural product, dairy has been utilised by humans for centuries. Thus, Linné argues that "there's a dairy fixation in Western societies, that we have to eat it that we have to put

it in everywhere." Consequently, and related to the overproduction of dairy, the dairy substance can be found in a variety of products where one would not expect it. In fact, Bengtsson Sonesson supports this fixation by elaborating on the dairy industry's ability to "integrate into every part of society and make themselves interconnected." Furthermore, interviewees argue that this fixation is not only driven by the industry but is also enabled by the strong agriculture lobby in the U.S., which will be further elaborated below. Consequently, according to Linné, a relation between politics, industry and dairy fixation can be established, that is for now rather a problem than a driver of change, thus holding back potential shifts within the dairy industry.

4.1.3 Role of the Government and Consumer

By means of the interviewees, the government has been identified as both a potential driver and impediment of change due to the previously highlighted dairy fixation (Linné). Interviewees emphasize that the strong agriculture lobby in the U.S. farmers protects the government due to national interests and stakes (Linné; Cooper A). Nevertheless, it is important to highlight that interviewees also argue for consumer power overweighting political power, indicating that if consumers demand a change, the government will not be the factor disturbing that change. In fact, interviewees agree that the consumer's power to mobilise change is higher compared to governments attempts to stop it (Linné; Hutson). Furthermore, Gandhi argues that "If you bet on government's you are still taking three decades from now for truly having transformational change.". Contrary to this, interviewees also agree that the government and regulations have the ability to foster change and thus can be a big influencer of sustainable change. Indeed, Cooper states that "power is quite prone to disruption itself. So as high-tech alternatives exist, you will get a lot of political power behind them." Hence, Bengtsson Sonesson also identifies the need for collaboration between the Dairy Industry and the government, to facilitate a potential transition.

4.1.4 Challenges for the Dairy Industry

According to the interviewees, even though the dairy industry is here to stay, the actors within this industry are increasingly facing new challenges driven by environmental sustainability.

Thus, Linné identifies the need to create new ways of consuming dairy as crucial for incumbent companies to compete with new entrants. While some interviewees state that the dairy industry has reached its innovation limit (Gaur) others state that the industry has revolutionized itself in the past 20 years and will continue to diversify and expand their innovation portfolio (Hutson). Nevertheless, Gaur argues that:

> "For the milk industry, there's only so much we can do. … It's an old industry, everything has already been tried. And we have reached a saturation already, in terms of what new could we do to it".

These contrasting views display the conflicting underlying change, with different industry opposition speaking in favor and against of the dairy industry. However, additional challenges that have been emerging in recent years are the price levels and the high competition within the dairy industry. In fact, Linné highlights that "the dairy industry's biggest issue is probably themselves.", indicating that the overproduction of milk producers is driving the price war between the players, pushing out small farmers who are not able to compete with economies of scale.

4.2 Innovations in Dairy

Following the challenges for the dairy industry is the introduction of new innovations to mitigate the same. According to Gaur, the rise of the concept of dairy alternatives is driven by factors for alternative diets such as veganism and the awareness of sustainability. Furthermore, the introduction of packaged milk with extended shelf life in the 1980s was hesitantly adopted as consumers did not understand the idea of the extended shelf life since prior to that milk was a fastly expiring product. Consequently, scientist "started looking into plant-based milks" (Gaur) as a product that in the consumer's mind had a better ability to have a high shelf life compared to dairy.

4.2.1 Plant-Based Innovation Case

Currently, alternative dairy products in the form of fluid milk alternatives are widely spread within the U.S. dairy industry. While some argue that the dairy alternative market benefitted from the dropped milk consumption by up to 40% (Gandhi), others state that the milk alternative market has currently reached a market size of 15% of the dairy market (Cooper B). Nevertheless, dairy alternatives, especially plant-based beverages, are no longer considered as a niche but rather a mainstream product that continuously "shake up the system" (Bengtsson Sonesson; Gandhi; Cooper B).

Plant-based innovations are characterised by offering consumers new and even superior value in the form of a more sustainable product. "With plants, the thing is you grow it and you milk it straight. So you take the cow element out" (Gaur). The arising tradeoff of potential higher use of other resources is not to be forgotten in this context. However, interviewees argue that there will always be less environmental impact with dairy alternatives as the livestock and its feeding is cut out (Gaur). Respecting the current product characteristics of plant-based beverages, Cooper states that:

> "plant-based milk is probably more of an alternative than a substitute, at least until people figure out how to use plant-based milk in the wide variety of things that we use dairy products for."

Furthermore, since plant-based milk are made from a variety of plants and crops, "there is no sort of standard in the consumer's mind for which is the more environmentally friendly alternative" (Cooper A). Hence, interviewees argue that even though the consumer would like to be more sustainable and aware of choosing the right product, it is yet relatively difficult considering the variety of and the missing standard of products. Additionally, while Gaur argues that plant-based innovations have different but superior nutritional value compared to dairy, Metzger states that plant-based innovation's ingredient composition is not comparable and never as nutritious as dairy. These contrasting views again display the intense debate on this matter. Nevertheless, respecting all interviewees insights on this matter it becomes apparent that plant-based innovations provide different but still nutritious value.

Consumer Adoption

As Pearson and other interviewees state, the trend towards plant-based innovation is increasingly growing. Thus, interviewees argue that there is an increasing mission-driven choice of consumers to switch to plant-based innovations due to new diets and the increasing awareness towards the global environmental implications of dairy (Cooper A; Gaur; Linné). Contrasting to this, Cooper (B) mentioned an issue from the experience of consumers when plant-based alternative had been initially introduced ten years ago. Thus, the possible dislike then combined with the relatively high price of the products offered now, impedes the traditional dairy consumer's willingness to try the products again. Thus, currently, roughly 80% of dairy consumers have little incentive to switch to milk alternatives (Cooper B).

Company Example: Elmhurst Milked

As a company example for transforming their business from traditional dairy producers to plant-based alternatives, Elmhurst Milked is reviewed. In 2015 the company's third-generation owner decided, with the age of 93, to transform the business. He recognised the trend of plant-based innovations and completely shifted from dairy production to nut- and plant-based products. The company is marketing itself as having "the cleanest milk ever, in the entire world" (Gaur) by including more nuts per drink compared to other players on the market. Hence, while they underwent a full transformation, they are also, according to Gaur striving for high-value, sustainable and vegan milk. Furthermore, the company is also reflecting the need for internal sustainability by recycling the water used for equipment in-house. Additionally, their product portfolio, according to them, benefits from a diversified range of products, including several different sorts of crop-based products, thus contributes to their ability to stay competitive (Gaur).

Premium value

Plant-based innovations are currently sold at prices respectively higher than traditional dairy products (Cooper A). Thus, the question arises whether plant-based alternatives can be considered as premium products. The interviewees agree that this question depends on the crop utilised for the plant-based milk. Thus, almonds are perceived as a high-value crop, while oat as a basic ingredient, is perceived as a low-value crop. Nevertheless, Cooper (B) argues that "nut-based milks have a limited niche for being premium products, because they are so intensive to

produce". Thus, companies producing milk from plants such as oats have a competitive advantage, since utilizing a cheap basic product and turning it into a premium product, results in a higher profit margin (Hutson; Cooper B). Consequently, one can derive that plant or nut-based products can have both different values and potentials but are currently perceived as a premium product overall.

Developments in Plant-Based

When it comes to the business implications plant-based entails, the focus is set on improving the efficiency of the production process towards having a cleaner technology that minimises waste in the form of water, land and energy (Cooper B). Many companies are adopting the innovation of plant-based by adding new product offerings to an already exhausted market. For firms such as Elmhurst Milked, this increasing competition was their initial motivation to innovate in the area of cleaner processes improving their product quality (Gaur). However, interviewees recognise the need for less diversification of plant-based offerings, due to the different environmental footprints. Thus, while almonds are seen as a plant requiring large water amounts, oats are perceived as a more environmental-friendly crop (Cooper A). Furthermore, the need for localized and regional production of the crops is necessary in order to decrease the environmental footprint (Linné).

4.2.2 Cellular Agriculture Innovation Case

As mentioned above, cellular agriculture enables the development of artificially produced products, thus making cellular agriculture products vegan, while still providing the traditional dairy taste (Gandhi). According to Hutson and Krueger, the entry of this innovation is both exciting but also threatening for players in the dairy market since it is viewed as a competitor to traditional dairy. In addition, and in contrast to plant-based innovations, it provides the same characteristic as dairy through a biochemical and genetic process. Therefore, cellular agriculture is perceived as a substitute for traditional dairy:

> “If you're able to produce plant-based cheeses that have similar characteristics to milk-based cheese, then I think the potential arises for a substitute. But ... I think they're more of an alternative than a substitute.” (Cooper B).

Furthermore, cellular agriculture provides several sustainability advantages in terms of offering dairy-like products without livestock or croplands (Gandhi). However, Krueger also mentioned the lacking perspective of the actual upstream sustainability costs of inputs, stating that: “depending on what organisms are making these products, they're going to need to eat something ... and that probably needed to be grown and possibly refined as well.” Potential upstream environmental costs for cellular agriculture is supported by statements from Metzger who emphasizes the large advantages to traditional dairy in this area. That is due to the need for controlling and monitoring, as well as resource deployment to, an artificial fermentation tank, which is required in the production of cellular agriculture. In contrast to this, Hutson highlights the advantage of dairy cows as they are a living fermentation tank with an ingrown ability for monitoring its natural processes. On the contrary, looking to downstream consequences, Krueger mentions the possible positive impacts on shelf life from a lab sterile product, thereby highlighting another sustainability aspect in terms of life cycles.

Consumer Adoption

Considering the potential consumer adoption required to reach high scale levels, Hutson believes that the consumer will demand a product that is superior in its nutrition and taste compared to current alternatives. A view which is complemented by Pearson emphasizing the demanded low environmental footprint of alternatives. The demand for cellular agriculture is confirmed by Krueger, pointing out the gap between current offerings and the increasing expectations of consumers. However, a contrary view is criticising the naturality of the product since GMO is present in the production process by claiming the “yuck factor” (Bengtsson Sonesson) will dictate rejection (Metzger). Additionally, Bengtsson Sonesson and Metzger argue that as long as dairy products are offered, environmental sustainability will not be a reason for consumers to switch to alternatives. A third aspect is raised by Gaur arguing for consumer adoption in relation to dietary choices. While vegetarians and switched vegans are allowed to consume dairy, indicating a pure substitute in taste might be wished for, an alternative is demanded by the consumer who does not wish to drink a substitute similar to milk but want another beverage.

Company Example: Perfect Day Foods

An example of a cellular agriculture innovation is provided by the California startup named Perfect Day Foods. The company was created five years ago with the mission to redesign the alternative supply chain for dairy proteins by utilizing fermentation instead of animal farming. The aim of creating the same protein with the same nutritional and functional aspect as traditional dairy emerged from a switch in diets by the co-founders. According to Gandhi the shift to veganism was difficult due to the lack of available nutritional products at hand.

> "Unless you're really mission-aligned, you are not going to spend more money for a bad product. If you can make the milk protein without the animal we could go back to eating all of our favorite products. And having a good impact on the planet." (Gandhi).

Perfect Day is a business to business, B2B, ingredient company aiming to sell their proteins to dairy producers and large corporations. According to Gandhi, it is impossible to tell a difference between traditional dairy and a Perfect Day product, indicating that the taste argument is fulfilled. With that in mind, Perfect Day predicts that the consumer demand for their product will be high, both for traditional dairy consumers and for concurrent vegans (Grandhi).

Commercialisation of Cellular Agriculture in Dairy

When examining Perfect Day Foods, it becomes clear that the market is ripe for the innovation, since cellular agriculture is perceived as the next challenge for industrial proteins (Krueger). Gandhi confirms the industrial potential, stating that "as long as you have a low carbon hybrid source and sufficient capital to put down the infrastructure you could sort of do this anywhere". Thus, the aim of redesigning the value chain of dairy opens different opportunities for players further down in the instances to produce dairy directly in their own plant (Gandhi). Coming from this, a strong view of Krueger is that cellular dairy has the potential for large change early on, however she incorporates a likelihood of it starting out as a niche product. The same commercialisation pattern is realised by Gandhi stating that in a short time horizon, the price offered will need to resemble a premium value due to initial cost disadvantages. However, in the long run, with an increasing scale, the price is expected to be lowered in order to compete with both traditional dairy and plant-based alternatives (Gandhi).

Perfect Day's chosen business model of being a B2B company is perceived as strategically smart by Cooper (B) who believes that their ideal market is not the fresh food market, but the ingredient market. The possible replacement of dairy protein by cellular agriculture is confirmed Hutson who also points to the cost advantages of economies of scale. According to Cooper (A) the plausibility for Perfect Day's B2B-model is further dependent on mimicking dairy in both taste and chemical aspects, along with offering a relatively inexpensive price. He continues to state that these attributes will attract large dairy corporations. Moreover, it is stated that the industrial protein substitute can, if commercialised rightly and adopted greatly, cause value chain implications by eliminating animal farming and having fermentation as a starting instance (Cooper B; Gandhi). The same is confirmed by Krueger stating:

> "Large companies are kind of watching and are very eager for this change to kind of come. But I think they are also very well aware that it takes a bit of a village to get these things off the ground in terms of company and infrastructure".

The demand on the corporate level for dairy producers is emphasised Gandhi describing that most firms would want to rather produce dairy than to import it, but are lacking the appropriate environment for it. According to Gandhi, that is the reason for industrial proteins being a plausible innovation, since it allows for production at any geographical location. Cooper (B) confirms this by stating that the business opportunities around cellular agriculture are very high due to the delocalisation of food production, enabling it to be closer to cities. This would in turn eliminate production hotspots and minimize the environmental problems associated with shipping from a few large plants located far away from civilisation. However, potential critics to cellular agriculture technologies are raised in concern of how green the innovation actually is, in regard to the inputs and resources used for production (Cooper A).

Developments in Cellular Agriculture

Continuing with developments of cellular agriculture, Krueger highlights the necessity of gradual efficiencies. Moreover, she states that the developments should be focused on increasing the protein count per unit, in order to drive down costs and improve the existing product. However, something that is heavily emphasised by the same respondent are the difficulties that companies in the dairy industry are facing due to the lack of upstream research- and institutional funding.

> “So, there's a lot of companies needing to invent the wheel themselves, just because this work has not been done. And that just slows things down ... And so, New Harvest is trying to work to be catalytic and get that government funding involved” (Krueger).

That catalytic development will according to Hutson and Krueger be the motor driving other players to become interested in the cellular agriculture field, as well as fuel the governmental support and infrastructure needed.

4.3 Impacts on the Dairy Industry

According to Bengtsson Sonesson, the disruptive potential of plant-based innovations has always existed, since the innovation and the technologies it required are considered as being new when it was first introduced. However, as mentioned above, since plant-based innovations are seen as an alternative and not a direct substitute competing against dairy, Cooper (A&B) claims that the disruption potential can be questioned. However, he believes that the disruption potential of cellular dairy is relatively large in comparison to cellular meat since it is an easier process in itself. Nevertheless, the common future challenge is focused on lowering costs and prices (Cooper A).

When discussing the potential for cellular agriculture to impact the U.S dairy industry, the notion that the growth may be fostered by large existing companies becomes evident. For that reason, some are more opting for the plant-based innovation, since it as an alternative and not a substitute, offers a new option whilst also being a good choice for the environment (Bengtsson Sonesson).

> “The way capitalist economies and agricultural food works is that the product change but the people that make the money remain the same and that happens at least at the corporate level. But the people likely to be squeezed out of that are the smaller farmers or even factory farmers. So, the people who stand to lose from this are farmers rather than the dairy or food companies themselves” (Cooper A).

Lastly, interviewees perceive efficiency and waste management for both cases as vital contributors to meet environmental sustainability challenges. Furthermore, Pearson continues that this is accompanied by being transparent and using metrics throughout the value chain. In order to neutralize waste, this knowledge can then decide where new process innovations are needed. Even though the two case innovation are also developed to decrease waste, the largest focus of efficiency is centered on improving waste management in the traditional dairy value chain. Particularly the farming instance, where industrial farms are opting to become carbon neutral, is affected by the increased demand for efficiency.

4.3.1 Large Farmers & Industrial Production

Similar to small farmers, interviewees agree that farmers unwilling to change are perceived as potential losers of the sustainable development. Hence, Linné and Cooper state that most of the farmers in the U.S. preserve the status quo and do neither react to the trend of environmental sustainability nor perceive it as a threat. While this, for small farmers, is often because of an inability to react due to hefty investments, large farmers are sometimes simply not acknowledging the change. Corresponding to this, Krueger argues that:

> "If anything, I think that it's larger dairy farmers that might see a reduction in their product, potentially, because these smaller farmers, I think, are traditionally pretty good at capitalizing on this storytelling."

Hence, according to her, the concept of storytelling in the form of providing sustainable or premium dairy and livestock can be better utilised by small farmers instead of industrial farmers. Nevertheless, interviewees state that economies of scale, meaning utilizing industrial mass production, will contribute to the ability of big farmers to survive this change towards dairy alternatives. Metzger and Hutson support this by elaborating that "what's really neat about these big corporate farms is they're very efficient, you know, and they're cleaner." Consequently, one can recognise that while industrial production may be doubted by consumers due to their unethical animal welfare (Linné), it is however more efficient and reduces waste within the value chain. This increase in efficiency results in business, making products cheaper and even more

competitive in their quality. Thus, one can already recognise that “the family farm is now going away basically, they're all these big corporate farms” (Hutson) who are seen to push small farmers out of the value chain. Lastly, Krueger also recognises an increasing investment interest of big industrial farmers in alternative dairy, indicating that large production facilities are increasingly recognizing this change as a business opportunity.

4.3.2 Small Farmers

As interviewees imply, small farmers have a difficult position within the changing environment of the dairy industry. These difficulties are not only originating in environmental sustainability but are also driven by the industrialization of the dairy production itself. Thus, small farmers do not only have to compete with large industry leaders in price but also increasingly fighting the battle of being as efficient as big production firms. (Hutson; Linné, Cooper A; Bengtsson Sonesson). Since small farmers can not directly compete with the high scales and the degree of efficiency demonstrated by big players, “they’re getting pushed out” of the industry (Hutson). Thus, the interviewees agree that small scale farmers are likely to be considered as the loser from the development of the industry. Nevertheless, some interviewees also state that small premium farmers can utilise their regional niche market by “making a premium product and taking care of your animals” and are therefore not likely to lose their business anytime soon (Gandhi). Nevertheless, this idea of a premium niche market is seemingly a conflicting topic since Gaur argues that “the small dairy and niche market, that kind of concept doesn't exist in this country”. Consequently, one can examine that the future of the small-scale farmers is difficult to predict, nonetheless all interviewees seem to agree that farmers that are unwilling to change are the losers of the sustainable development of the U.S.

4.3.3 Business Collaboration

Another area of interest is the future development and existence of traditional dairy. Hutson and Metzger believe that there is room for traditional-, cellular dairy as well as plant-based alternatives in the market. This is, according to both interviewees, in connection to the evident

population growth demanding alternative methods of human feed. Coming from this, developments of both plant-based and cellular agriculture innovations should be seen in a positive light (Metzger). “So, I think they can exist together and maybe even if they are in the same market, they work together to help boost overall nutrition” (Hutson). On the note of joining large dairy corporations with entry firms, such as Perfect Day, a collaboration is something that Hutson addresses as likely. Furthermore, he also raises the appropriateness of a co-optation between traditional dairy and cellular agriculture, rooting from the fact that traditional dairy will not be diminished in the U.S, but exist together with the new innovations.

4.4 Summary Table of Empirical Data

In order to visualise the empirical findings in a manageable way, a summary of the two case innovations is illustrated in the following:

Case 1: Plant-Based Innovation	**Case 2: Cellular Agriculture Innovation**
An alternative to dairy	A substitute to dairy
Driven by changing diets	Need for offering competitive price and mimic dairy attributes
Currently high-value, relatively high price product	Potential to reach mainstream market share
Limited growth potential	Potential to greatly affect status quo of the dairy market
Difference between high-value and low-value crops (Almonds vs. Oats)	Scale disadvantage for small farmers
No standard “most environmental friendly” product, great variety of products offerings	Commercialisation opportunity for large farmers and dairy producers

Table 2: Summary Table of Empirical Findings

5 Analysis and Discussion

5.1 Plant-Based Innovation Case

5.1.1 Type of Innovation

Plant-based innovations are characterised as offering new value to a specific customer group in the form of dairy alternative products that are higher in price and aimed at delivering an alternative or even higher value to the customer (Cooper). This innovation is driven by the environmental sustainability trend that is currently growing of interest in the U.S. and is continuously adopted by companies as a business case (Linné). Considering the given literature of business model innovation and the interviewees' statements regarding plant-based innovation one can categorize plant-based innovations as an initial business model innovation (Markides, 2005). One argumentation for this is its characteristic of invading an existent market by offering a different dimension of the product, namely non-dairy products that are however still utilised for the same purpose (Markides, 2005). Furthermore, plant-based alternatives are not categorized as a technological innovation since this kind of innovation is differently adopted by consumers (Markides, 2005). Plant-based alternatives have existed in the U.S. market since roughly 20 years (Gaur), but have not substituted nor completely changed the dairy industry yet. Instead, it only quickly grew to a specific share of the market, namely 15 percent, which contributes to its classification of an initial business model innovation. Plant-based innovations currently do not show the attributes of an innovation that will crucially change the status quo of the market but it has rather developed into incremental innovations that are continuously adopted by companies as the source of a product or market extension (Rubin & Abramson, 2018). Lastly and corresponding to the argumentation above, as the name plant-based alternative entails, plant-based beverages are not perceived as a substitute but as an alternative to dairy products. Thus, they create the need for alternatives that are not directly destabilizing an existing market but instead creating its own niche (Markides, 2005).

Company Example: Elmhurst Milked

Considering the interviewees' perception of Elmhurst Milked, one can instantly perceive it as quite radical and unique business transformation example. However, a radical business change does not imply that the innovation itself is radical. In fact, as an initial incumbent firm Elmhurst Milked can be categorized as a late entrant who adopted the business model innovation (Markides, 2005) of plant-based alternatives, but technologically improved it by implementing a new clean technology for enhancing the product formulation (Rubin & Abramson, 2018; Schumpeter, 1934). Therefore, Elmhurst Milked's new business model is based on a process innovation (Varadarajan, 2009) that consequently lead to an improved product benefiting from higher value. Thus, their technological innovation in the processes area leads to a product innovation, which subsequently, when respecting the dairy industry, can be characterised as an incremental innovation of dairy alternatives as it improved the existing version of a plant-based product (Ghosh, Kato & Morita, 2017).

5.1.2 Disruption Potential

Plant-based innovations are characterised by their nature to offer customers superior value at a relatively higher price. Thus, when respecting Christensen's (1997) definition of disruption, plant-based products would not fit into his perception of a disruptive product. Nevertheless, as Govindaraja and Kopalle (2006) highlights, disruption can not only occur from low-end but also high-end. Thus, according to them, plant-based innovations are yet another example of another dimension of disruptive innovations.

One can note, that the underlying driver of these higher value dairy innovations is the concept of environmental sustainability. As people increasingly become aware of the importance of being more environmentally friendly, the demand for establishing higher value products was recognised (USDA, 2019). Thus, while consumers in the past only focused on buying the cheapest and simplest products, consumers now are willing to spend more on respectively enhanced and better value products (Laroche, Bergeron, & Barbaro-Forleo, 2001). Therefore, a connection between the phenomenon of environmental sustainability and the introduction of higher value products that have the ability to impact the industry is established. Consequently,

the change perceived in the U.S. dairy industry can, if it continues to grow, have the underlying ability to change or even disrupt the market with higher value products (Govindaraja & Kopalle, 2006), despite contradicting theory (Christensen, 1997). Referring to the above, it is again important to note that an innovation, in this case, a business model innovation, can be characterised as disruptive even if it only grows to a certain market share (Markides, 2005).

Still, one needs to acknowledge the importance of Christensen's (1997) definition of disruption and Schumpeter's (1942) discussion about creative destruction. According to them, plant-based innovations do not have the ability to push out traditional dairy from the market, thus not cause destruction within the industry. Therefore, it is recognised that for some authors plant-based innovations can be characterised as disruptive (Govindaraja & Kopalle, 2006), however for others it is not (Christensen, 1997). Therefore, the research settles upon the characterization that plant-based innovations may not have the capability to disrupt the entire dairy industry, but have already demonstrated its ability to affect certain actors within the value chain. As previously mentioned, a misconception of disruption clarified by Schmidt and Druehl (2008) is that disruption does not need to replace existing businesses, but still have a major impact on the market by offering a new dimension of an existing market (Markides, 2005). Thus, while the empirical findings have shown that dairy is perceived to always exist, it can still be affected by the increasing growth of plant-based innovations. Furthermore, the disruption potential of plant-based innovations also depends on the type of plant-based innovation. Since Christensen's (1997) definition of disruption is still acknowledged by many authors, true disruption is more likely to occur if products are offered at a lower price. Hence, innovations that can reap more protein per unit, introduced by Elmhurst, may allow the companies to scale up and therefore lower their cost and price. But as interviewees have stated, the high-value crop will remain a high-value product. Therefore, the plant-based innovation of oats, as a lower value crop compared to nuts, is more likely to produce products at a lower price, resulting in a higher disruption potential. Consequently, it is apparent that plant-based innovations have the ability to impact or change an industry, however being an alternative its disruption potential according to Christensen (1997) is only partially apparent.

5.2 Cellular Agriculture Innovation Case

5.2.1 Type of Innovation

Cellular agriculture's close resemblance and ability to be a literal substitute is emphasized by several interviewees and perceived as its success factors for its approaching commercialisation. Conclusively, if the innovation is introduced with a low price and provides the same or superior characteristics compared to both traditional and plant-based innovations it has the ability to compete with both (Christensen, 1997; Govindarajan & Kopalle, 2006). With the empirical findings in mind, cellular agriculture entails the introduction of a new process (Schumpeter, 1934). Thus, the artificial way of producing a product that resembles dairy in taste and texture, thereby fulfilling a similar market need to dairy (Schilling, 2017) is not altering consumer's current habits. Furthermore, the rise of cellular agriculture as for now is driven by new entry firms focused on incorporating the technology to the core of the business. This indicates that the type of innovation is not viewed as an add-on to a business model and thus cannot be characterised as incremental (Ghosh, Kato & Morita, 2017).

Respecting Markides (2005) typology, cellular agriculture can, on the one hand, be characterised as technological disruptive innovation. This is due to the innovation's characteristic of being a substitute to dairy implying that it has the ability to replace traditional dairy products (Schumpeter, 1942). On the other hand, cellular agriculture could also be characterised as a radical product innovation since it is new to both customers and companies, indicating that they rather arise from a supply-push (Markides, 2005). However, since the innovation of Perfect Day is driven by a need for a nutritional substitute to dairy, representing a demand-pull, the above statement is only partly applicable. Another dissimilarity to radical product innovation is its attribute of changing a consumer's predominant habits. Since cellular agriculture is viewed as a substitute, it is aimed to fulfill similar needs by replicating the traits of dairy, thus not disturbing consumer habits but altering the ingredients of the product. Despite this, cellular agriculture resembles radical product innovations as it will be introduced at a premium price that initially,

according to Markides (2005), attracts early adopters and only reaches a larger customer group once it is lowered (Rogers, 1983).

However, since the innovation is founded on a new technology, enabling an artificial production of a protein and not an end-product, it should be considered as a *Technological Innovation.* Thus, the technology enables the artificial re-creation of the milk protein, allowing the end product to look and taste like dairy.

Company Example: Perfect Day Foods

Perfect Day Foods is a company that implemented cellular agriculture innovation in the context of the dairy industry. Thus, their milk protein innovation can be also characterised as a technological innovation due to its similarity to dairy in the final product attributes (Markides, 2005). Moreover, being a SME Perfect Day tackles environmental challenges with an entrepreneurial mindset, enabling the startup to be a first-mover according to Moore and Manring (2009). Thus, by introducing a new production process, which eventually results in a new product composition generates potential gains from this innovation (Lieberman & Montgomery, 1990). In addition, the company benefits from a small firm innovation advantage, as large dairy corporations can not adapt to new innovations as quickly (Senge et al., 2008). These benefits may be the basis of a long-term competitive advantage that is complemented by having an in-depth involvement and knowledge about the innovation, that second movers would not be able to gain (Kerin, Varadarajan & Peterson, 1992). Nevertheless, the first-mover disadvantage for Perfect Day is the cost- and resource advantage of second-movers (Kerin, Varadarajan & Peterson, 1992; Markides, 2005, Moore & Manring, 2009). Perfect Day attempts to overcome this challenge by forming partnerships with large dairy producers, thus earning scale and profit early on in the process. Consequently, this supports the argumentation of technological innovation as it entails the gain of a large market share, which is supported by the advantages associated with a first-mover (Markides, 2005).

5.2.2 Disruption Potential

Once distinguishing the type of innovation, the disruption potential is in need of evaluation. Due to the uncertain nature of the development of cellular agriculture, the research only examines its disruption potential in theory and not in practice. For this purpose, Perfect Day will serve as an example of cellular agriculture innovations.

As highlighted by Gandhi, the likelihood of Perfect Day being able to offer a competitive price in a short-term horizon is limited, indicating that their innovation will not adhere to Christensen's (1997) development of disruptive innovation of reaping large consumer adoption with a low price. Thus, due to the lower scale and commercialisation Perfect Day initially needs to set a higher price to cover costs. As Govindaraja and Kopalle (2006) highlight disruption can occur on both the high and low-end spectra. Therefore, the technological cellular agriculture innovations would support this note as they are introduced with a higher price as a niche product that aims to gradually evolve into a mainstream product by lowering costs and competing in economies of scale (Rogers, 1983; Yu & Hang, 2010).

Continuing, it is enforced that disruption does not necessarily need to cause destruction of businesses or replace incumbent firms (Schmidt & Druehl, 2008). Thus, contradicting to Christensen (1997) and Schumpeter (1942) the cellular agriculture innovation can be disruptive even though the dairy market is likely to not fully be destructed. However, it is recognised that products have a higher disruption potential if they target an underserved product attribute (Schmidt, 2004). Thus, if the cellular agriculture innovation introduces a substitute to dairy with higher or equal performance and a low price, the disruption potential will be correspondingly high (Christensen, 1997). Consequently, the innovation can eradicate the status quo of the dairy market but is likely to have a higher disruption on the market conditions itself rather than the actors within. This is due to Perfect Day's B2B approach that aims to collaborate with large dairy players. This corresponds to Charitou and Markides (2003) stating that incumbent firms can respond to instead of copying new innovation, thus utilizing the innovation in their own

favour. Such collaborative nature of MNCs and SMEs is further highlighted by Moore and Manring (2009) as a method of creating higher value synergies together rather than individually.

5.3 Comparative Analysis

Generally, as Schmidt (2004) indicates the dairy market can be perceived as ripe for disruption as an overshoot of dairy products with similar attributes exist. Thus, plant-based innovation, as well as cellular agriculture, have the potential to introduce product attributes that may be significantly underserved. Whereas plant-based innovations could succeed with a crop-based, lower priced product such as oat milk, cellular agriculture could utilise its advantage of requiring no farming instance but still providing the dairy nutritional value as their selling point.

The gravest difference between plant-based and cellular-agriculture innovations is its characteristic of either being an alternative or a substitute. While plant-based innovations are even referred to as alternatives, our findings support that stakeholders from different groups are categorizing plant-based products as an alternative to dairy products. This is, according to the interviewees, mostly due to plant-based products' inability to reproduce the taste and its inability to provide the same nutritional value as milk. Lastly, as consumers do not view plant-based products as a substitute for dairy, they so far have not integrated plant-based products into their nutritional habits in the same way they currently consume dairy products. Contrary to this, cellular agriculture aims to copy taste and performance of dairy by and thus displays a substitute to dairy. Consequently, this difference also contributes to the projected market share of both innovations, entailing that cellular agriculture innovation being a substitute is likely to have a higher market share than the alternative of plant-based innovation (Markides, 2005). This also corresponds with the distinction of plant-based being a business model innovation while cellular agriculture is characterised a technological innovation. Consequently, as previously discussed, these different types of innovation directly have contrasting adoption and growth rate within a market (Rogers, 1983; Markides, 2005).

Therefore, this research examines that compared to plant-based innovations, cellular-agriculture innovations have a higher potential to disrupt a larger share of the industry. While plant-based innovations are likely to continue to grow as an alternative and only *disturb* a segment of the dairy industry (Markides, 2015), cellular agriculture innovations have the ability to substitute and *disrupt* dairy products in the same way Christensen (1997) describes disruption. Thus, the research recognises the difference between disturbing and disrupting a market which will be further highlighted in Chapter 5.5.

5.4 Value Chain Implications for Upstream Actors

In this chapter, the value chain implication for upstream actors and their business strategy is reviewed and discussed. These are assessed by focusing on the steps within the value chain that are likely to be affected by both plant-based and cellular agriculture innovation. Hence, the upstream value chain including farming, transporting and processing will be utilised to illustrate the disruption potential from the mentioned innovations.

5.4.1 Farming

Cellular Agriculture Implications

Both plant-based and cellular agriculture innovation have an impact on the farming instance of the value chain. The first and strongest distinction to be made is that while plant-based innovations require another form of farming, cellular agriculture innovations do not require a farming instance at all. This is due to the innovations ability to be artificially produced, thus not requiring crops or livestock, but different resources. Nevertheless, since the innovation is yet to be introduced to the market the actual implications of this innovation on the farming instance is still unknown. However, when considering the innovation theoretically (Christensen, 1997; Schumpeter, 1942), its disruption potential would indeed make the farming instance obsolete once it is commercialised into a mainstream market. Consequently, in theory, farmers, both small and large, would be heavily affected and even pushed out of the industry by cellular agriculture innovations.

Plant-Based Implications

Similar to cellular agriculture innovation, plant-based innovation also impacts traditional small and large dairy farmers. However, while cellular agriculture innovations do not require the farming step, plant-based innovations are produced by utilizing crops. Consequently, from a theoretic perspective, if this sort of innovation continues to grow, livestock farmers in the U.S. would eventually be redundant. However, since a farming step is still required, farmers could adapt from livestock to plant-based farming. As the example of Elmhurst Milked shows, a transition from dairy to non-dairy is possible. Nevertheless, it is important to note that plant-based innovation has already existed in the U.S. dairy industry for two decades. Therefore, the current implications for farmers by plant-based innovations are present but support the previously indicated findings of plant-based being an alternative but not a substitute to dairy. Hence, only a small share of farmers, particularly small farmers, are currently affected by innovation. This is due to their inability to react to upcoming changes as a result of their previous investment to maintain a competitive position within the dairy industry that will be elaborated below. Consequently, one can not refer to the implications for farmers as being disrupted by plant-based innovations, but instead as being disturbed or affected by it.

Industrial Production

Nevertheless, in all these mentioned implications of dairy innovations, it is important to highlight that these are assumptions based upon theoretical and practical findings. Therefore, it is necessary to also include the current implications of environmental sustainability and the increasing industrial production in the farming instance. In the past years, a phenomenon of environmental sustainability increasingly drove the need for efficiency and enhanced waste management (Fiksel, 2017). Contributing to this are the growing price and competition wars within the U.S. dairy industry, leading to small farmers being unable to maintain the same scale as industrial farmers. Therefore, economies of scale have already been apparent in the dairy industry, even before the environmental sustainability trend arose. Consequently, producing dairy in large scale is currently dictating the farming instance. Thus, a difficult issue for small farmers is their inability to produce dairy on a large scale resulting in only larger dairy producers utilizing the concept of economies of scale, further enabling efficient production.

As an additional burden, especially for small scale farmers, plant-based and cellular agriculture innovations are not benefiting their position. Furthermore, this research identified that the dairy industry will continue to exist. Due to the mentioned strong competition, the increasing need for efficiency and zero waste within the industry pushes out small farmers out of the value chain. This phenomenon is often referred to as creative destruction, indicating that small farmers are creatively destructed by both the push of environmental sustainability and innovations as well as through economies of scale (Schumpeter, 1942; Hart & Milstein, 1999).

Thus, the potential of being disrupted by either innovation is stronger for small farmers compared to industrial farmers due to their access to the needed infrastructure and resources to react to that threat (Fiksel 2017; Nidumolu, Prahalad & Rangaswami, 2009). Thereby, industrial farmers can maintain their traditional dairy practices and compete on a price level with its substitute, cellular agriculture. As Hart and Milstein (1999) suggest, since the U.S. is a developed country, and the dairy industry is an inert market, challenges for them are centered around reducing footprint. This indicates that industrial farmers should opt for value chain management and a reduction in waste to contribute to the green environment.

5.4.2 Transport

When reviewing the disruption potential of both plant-based and cellular agriculture innovations it became apparent that it also affects the step between the two large upstream instances. Reviewing plant-based alternatives firstly, the potential elimination of livestock farming, although quite unlikely, still requires crops to be harvested and transported to production facilities. Hence, this upstream value instance is still needed, however with the apparent environmental sustainability challenges, in need of a reduction in footprint by adopting cleaner methods of transportation (Fiksel, 2017).

Cellular agriculture, being a substitute and not an alternative to dairy, does, contrary to plant-based, fosters the delocalisation of production and thus changes the composition of the value chain. Consequently, by having artificial fermentation as a starting instance it cancels out farming as a necessary part in the production stream. Therefore, the transport instance would be

negatively affected due to the eliminated need for transporting crops, milk or other resources between a farmer and a processor. With that said, the disruption potential of cellular agriculture is as for now hypothetical and predicted to be realised gradually, meaning the use of transporting will not disappear any time soon. Furthermore, it is important to note that cellular protein also requires transportation from the company in question, for example, Perfect Day, to the relevant processing actor.

5.4.3 Processing

Plant-Based Implications

Comparing the value chain implications in the processing instance to farming, the effects are stronger for farmers compared to actors within the processing stage. Plant-based innovations originate from the idea of utilising another form of resources or ingredients in the farming step. Thus, the strongest effect of plant-based innovation is connected to the farming instance. The technology required for a dairy producer to incorporate plant-based into their product portfolio does not require extensive alterations, which is complemented with the fact that the technology has advanced and is continuously implemented by larger players in the market already. Therefore, in this research plant-based alternatives are considered as an opportunity rather than a threat for dairy producers, based on the evident second-mover advantages from an already established technology and consumer base (Bikhchandani, Hirshleifer & Welch, 1998; Wu et al., 2019). Nevertheless, the lack of institutional funding requires the potential transition to plant-based innovations to be dependent on a large amount of resources, knowledge and investments.

Consequently, actors in the processing instance affected by the potential increase of plant-based innovation can react to this change in several ways. Either, their strategic outlook is based upon Charitou and Markides (2003) stating that incumbent firms do not need to adopt the innovation in question, but can instead invest in improving the existing business. Thereby they develop prevailing product s-curves and gradually expand their market share (Ghosh, Kato & Morita, 2017; Rubin & Abramson, 2018). Another option for processing actors is to deploy an imitation strategy to innovation in which the existing firm utilises a second mover advantage by exploiting the improved version of the plant-based innovation, thus targeting the current consumer base for

plant-based products (Schilling, 2017; Wu et al., 2019). This is strategically beneficial exploitation of cost since the legitimacy of the innovation has been proven by previous actors (DiMaggio & Powell 1983; Katz & Shapiro, 1985). Both the former and the latter strategy to react to the growth of plant-based innovations is witnessed in the U.S. dairy industry as the imitation of plant-based products into an existing business model has been increasingly observed. This implies that the realised effects of plant-based innovations within the value chain are currently not overthrowing actors as Schumpeter (1942) would predict, but instead extending the offerings available and actors active on it. Thus, this encompasses a disturbance to the market.

Considering the company example of Elmhurst, this radical business model shift from an incumbent actor is rather perceived as a unique case than a standard procedure. Incumbent actors are usually rather hesitant to adopt an innovation which consequently slows down consumer adoption (Markides, 2005). Furthermore, a response in the form of introducing efficient waste management systems or extending product portfolios, thus incrementally adapting the business model, is more likely for actors within the value chain.

Cellular Agriculture Implications

Since cellular agriculture innovations are not yet commercialised, only potential implications will be highlighted in this section. The study examined that actors within the processing instance do not necessarily suffer from the cellular agriculture innovation but can instead utilise it as an opportunity. Due to cellular agriculture entailing the production of new raw material, a protein, dairy processors can purchase this and continue producing *the same* product type. This is enabled through the B2B model introduced by Perfect Day, or the sharing of technological innovations in the cellular agriculture field. Regarding the disruptive innovation introduced by Perfect Day, one can consider Moore and Manring (2009) proposition of complementary aspects of joining SMEs and large firms, MNC, in business. Moreover, a competitive advantage can be created by combining technology innovation and the ability to deploy resources into efficiency management (Porter & van der Linde, 1995). Thus, by opting for a joint set of resources to create a sustainable business a beneficial synergy is created. Thus, by collaborating with larger processing firms to

reach the highest scale of production Perfect Day is able to introduce their mission-driven innovation to market, whilst offering a competitive price to traditional dairy.

Moreover, a transparent business needed to strengthen this collaborative nature of SMEs and MNCs as in a B2B-model is highlighted by (Soosay, Hyland & Ferrer, 2008). Consequently, this contributes to arguments that collaboration plays a vital role in the developments of the dairy industry as a whole. However, the same conditions of size and resources of the producer as for the plant-based innovations are apparent. In fact, since Perfect Day is aiming to collaborate with large players, medium or small sized companies would consequently not play a vital role in the development of cellular agriculture within the processing instance. Thus, while technicalities are not highlighted, it became apparent that the process of producing products from cellular agriculture requires new but simple processes. In the case of protein innovation, interviewees highlighted that the process can be fairly easily adopted by corporations that possess the necessary resources. Thus, large processing actors active within the dairy industry can benefit from the commercialisation of cellular agriculture while small scale processors are not able to invest and restructure their processes.

Respecting this, a critique can be brought forward challenging the true disruptiveness of this innovation as it is introduced through established firms. This results in the same firms benefiting from the innovation in ways that do not change the status quo of the market. Nevertheless, the introduction of the innovation to the market also benefits the new entrant Perfect Day as it fosters the prevalence of cellular agriculture and simultaneously contributes to the preservation of traditional dairy players. Thus, concurrent conditions can be disrupted, because even though it is not characterised as a destructive innovation, the innovation can still be disruptive for traditional dairy and some actors in the value chain (Schmidt & Druehl, 2008). Furthermore, since cellular agriculture is an innovation created in connection to the processing step, the largest negative implications are seen on the upstream levels before the processing instance. Considering such, the disruption potential is large, however, as stated before, purely dependent on the innovation's future performance.

5.5 Revisiting the Conceptual Model

In this chapter, the the conceptual model presented in Chapter 2.6 is revisited in order to present and discuss revised and added factors.

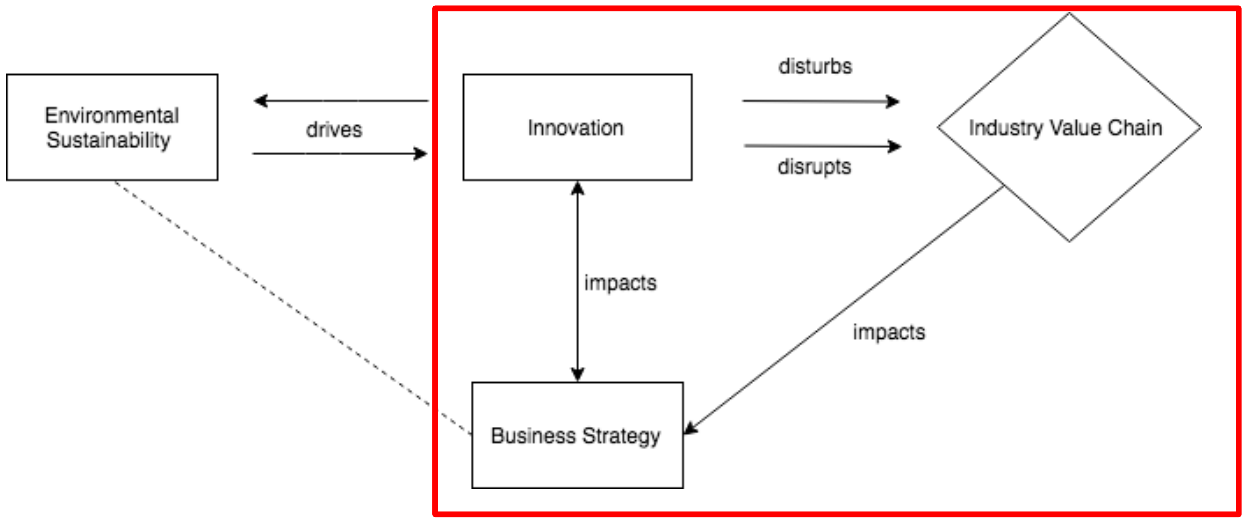

Figure 2: Revisited Conceptual Model - Degree of Disruption

5.5.1 Degree of Disruption

As disruption and its potential to impact the value chain is a major component of this research, the link between innovation, disruption and value chain will be first examined. As an initial premise, the link between innovation and industry value chain was characterised by disruption. However, this research has identified different business and value chain implications, which differ depending on the type of disruptive innovation and influence its degree of disruptiveness. Hence, as this conceptual model displays a flow between the individual concepts, the factors influencing the disruption degree also have an effect on both the value chain and business implications. Consequently, and adding upon the initial conceptual model we established a positive relationship between the degree of disruptiveness and the impact on the value chain and the actors within it. Hence, if the degree of disruptiveness is low as in the case of plant-based innovations, the impact on the value chain or actor is low. In contrast to this, if the degree of

disruptiveness is high as for cellular agriculture innovation, the impact on the value chain and its actors is relatively higher.

Type of Innovation and Disruption

As Markides (2015) states, disruptive innovation can originate in different levels and types of innovations. Following his approach, we characterised plant-based innovations as a business model innovation due to its attributes of invading the existing dairy market by offering a new dimension to the initial product. Furthermore, as previously highlighted, its adoption rate of only reaching part of the market is also a typical characteristic of a business model innovation. In contrast to this, cellular agriculture innovations are characterised as a technological and partly radical new-to-the-world innovation. Consequently, its development on the market and degree of disruption is considered to be stronger, as the innovation encompasses the ability to be a substitute instead of an alternative, by competing in price and characteristics. In detail, this study has examined that the categorization of the type of innovation is significant for its subsequent performance on the market. Thus, we observed that there is a relation between whether an innovation is perceived as an alternative or a substitute and its realised degree of disruptiveness on the market. Consequently, the disruptiveness increases the more the innovation displays an actual substitute. Accordingly, this is in line with Markides (2005) typology, arguing that different types of innovation have dissimilar effects on firms, markets and competition but can yet be perceived as disruptive. Furthermore, our findings are in line with Christensen (2006) who argues that disruption also is a relative phenomenon, indicating that while some companies are disrupted by an innovation others may not be. However, this study adds upon the theory by emphasizing the importance of the innovations' categorization of either being a substitute or an alternative.

Another factor contributing to the realised degree of disruptiveness is the firm's ability to scale up their production and thus decrease their initially offered price. Consequently, the study agrees with Christensen's (1997) view that low price innovations have a higher ability to disrupt the market. Nevertheless, we acknowledge Govindaraja and Kopalle's (2006) argument that disruption can occur from both low-and high-end, however, the disruptive potential is stronger if competing at a lower price.

Realised Disruptive Effect

Respecting the above, this research examines that plant-based innovations are not realised as a disruption, even though some scholars argue that their innovation attributes are considered as disruptive (Govindaraja & Kopalle, 2006) while others strictly oppose this argumentation (Christensen, 1997). Instead, it is a high-value alternative that invades the market in a *disturbing* matter. Thus, when referring to plant-based innovations expanding or extending the dairy market one could consider using the term disruption, however, cannot refer to the traditional concept which Christensen (1997) and Schumpeter (1942) propose, as this entails that actors within the value chain are completely replaced. Instead, disruption here indicates *disturbing* the status quo in terms of reorganizing the market by opening new opportunities to thrive, while simultaneously partially impacting incumbent firms within the process.

Subsequently, one can argue that environmental sustainability is a factor that changes the need of the market and consumers, implying that since consumers value "high-value" increasingly more the trend becomes generally acknowledged. While Christensen (1997) focuses his argumentation around disruptive innovations being characterised by smaller, more convenient and lower performance products, we argue that the underlying notion of environmental sustainability also drives disruptive innovations that have superior value. Hence, a disruption can also occur when the product's intention is to provide higher value and thus contribute to the bigger picture of environmental sustainability.

In contrast, the argument for cellular agriculture being a disruptive innovation is stronger, as according to Christensen (1997) and Govindaraja and Kopalle (2006) definitions, the product should represent a substitute to dairy. Hence, once produced on a large scale and offered at a lower price, it has a high potential to disrupt the dairy industry through a delocalisation of production. Thus, by utilizing fermentation as a new starting instance of the value chain the need for farming and transportation is eliminated. Despite this likely elimination in theory, a practical realisation could potentially turn out to be smaller than anticipated by these scholars. However, looking to the evident change in consumers attitude, consumer adoption may increase even exponentially with time. Nevertheless, as the innovation has not yet entered the market, the research only considers the theoretical implications of cellular agriculture innovation.

Consequently, the effects from different disruptive innovations can be realised differently, contrasting both Christensen (1997) and Govindaraja and Kopalle (2006) in that it always disrupts in terms of overtaking existing players or products. Instead, we propose that depending on the type of disruptive innovation it has the ability to *disturb* or *disrupt* a market to different extents, thus supporting Markides (2005). Nevertheless, we adhere to Christensen (1997) that the more disruptive potential an innovation encompasses, the more potential it has to negatively affect actors within the industry, eventually making them obsolete. Consequently, what this research further aims to propose is to combine the three mentioned scholar's statements, thereby adding a complementing theory of disruption, in which all three aspects are covered.

5.5.2 Innovation and Business Strategy

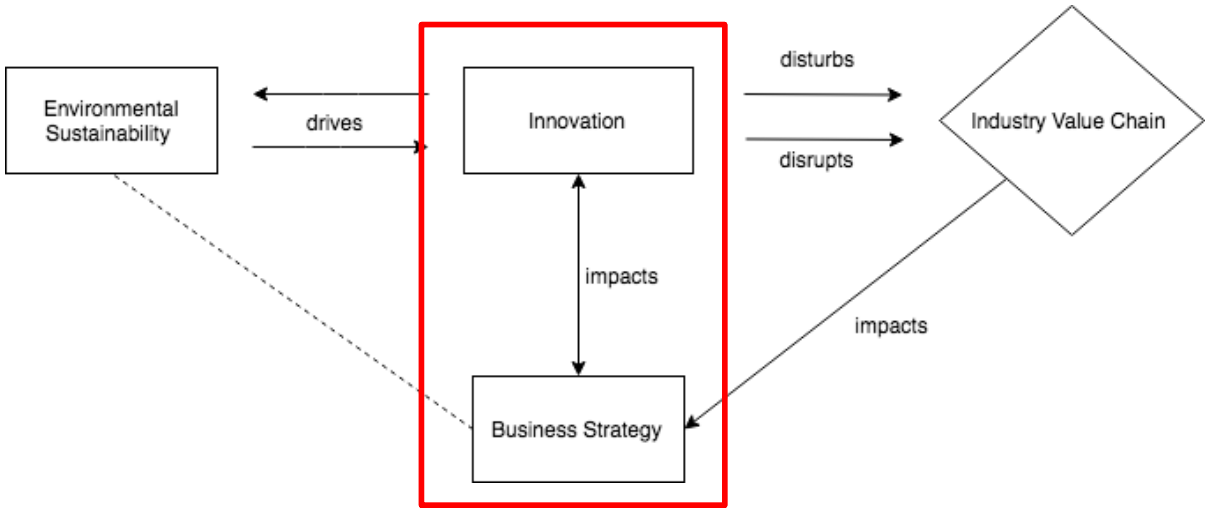

Figure 3:Revisited Conceptual Model - Innovation & Business Strategy

As highlighted in Chapter 2.6 a two-way relationship between Innovation and Business Strategy has been established. In fact, scholars support that the radicalness of the company's chosen business strategy influences the type of innovations it decides to focus on and further contributes to them being an early mover or a late follower (Lieberman & Montgomery, 1990).

The two cases of plant-based and cellular agriculture innovation support this finding as a positive relation between the radicalness of a business strategy and the company's choice of *investment* in

innovations could be established. Furthermore, a relationship between the innovation type and the company's reaction towards adopting the innovation is examined. Hence, being an early adopter is positively related with the business strategies' radicalness, while late adopters/entrants usually have a less radical business strategy. The above is supported with the general findings of this research's cases of cellular agriculture and plant-based innovation, whereas the former is perceived as a high potential disruptive innovation and the latter as less potential disruptive innovation, only disturbing the value chain.

However, one of the within-case company examples contradicts with the given relation between radical business strategy and the disruptiveness of the chosen innovation. Consequently, even though Elmhurst Milked's shift from a dairy to a plant-based producer is perceived as a quite radical strategic decision, the company did not invest in a product that has the characteristics of an innovation with high disruption potential. Instead, the company incrementally improved the existing innovation of plant-based and implemented this in a radical way by changing their complete business model. Consequently, this contradicts with the given framework that radical business strategies invest in the type of innovations that in best case scenario lead to a disruption of the market. This finding demonstrates that exceptions to the utilised theoretical framework exist and highlights that a company's radical choice of strategy does not necessarily lead to the highest possible disruptive impact.

5.5.3 Environmental Sustainability and Innovation

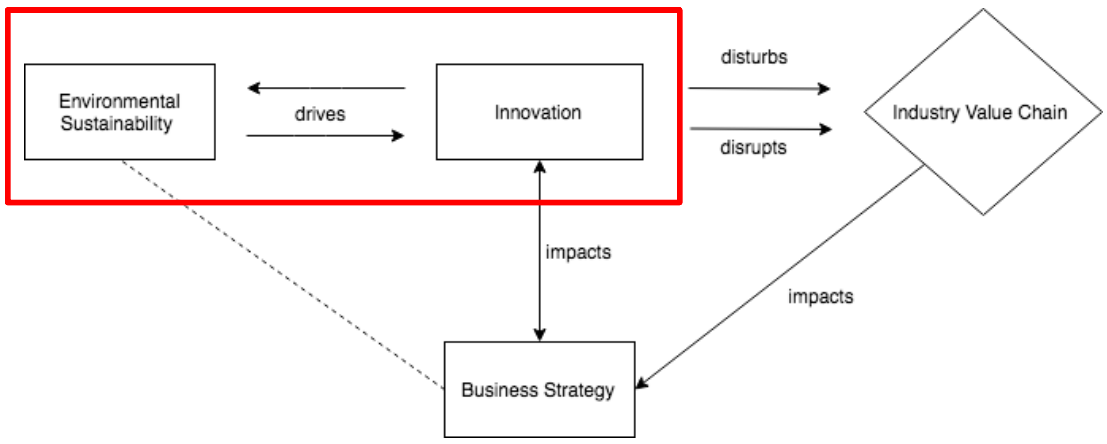

Figure 4: Revisited Conceptual Model - Environmental Sustainability & Innovation

Another area of interest in our conceptual model is the relationship between environmental sustainability and innovation. In the initial demonstration of the model, a relationship of environmental sustainability driving the creation of innovation, thus driving the disruptive change within the industry was established. In addition, the research also recognised that this relationship is bilateral, indicating that innovation, even though not intentionally, drives environmental sustainability. Consequently, the presented literature focuses on environmental sustainability and innovation relationship but has not deeply acknowledged the relation in reverse. In contrast, our findings indicate the importance of the relationship flow of innovation and environmental sustainability.

This research derives that despite being the initial motivator for a sustainable solution, environmental sustainability is often a by-product of innovations. In fact, while environmental sustainability is the underlying notion and potential side effect from innovations, the initial driver of firms is the ability to realise a profit. Thus, this is in accordance with Porter & Kramer (2011) stating that establishing a business case is necessary in order for companies to realize a sustainable benefit. Especially, in this research, the two cases are based upon a mission-driven approach but are rooted in a business case. This fact has even been endorsed by the company example Perfect Day stating that they need to take over the market together with large players, thereby realizing the cost and scale rationale required for a successful business. Thus, this further adheres to Goodland (1995) who states the importance of integrating social, environmental and economic value in order to remain successful.

Nevertheless, another dimension which is noteworthy to highlight is the direct link between environmental sustainability and efficiency. In this research, efficiency is related to waste and loss management which in turn has a positive effect on optimizing processes and thus reducing costs. Respecting the innovations in dairy, the efficiency argument also becomes evident at the commercialisation stage where the need for scaling economies is put forward. This is adhering to Tushman (1997) suggesting that incremental innovation follows disruptive innovations in that efficiency is vital for commercialisation, even for dairy innovations. Thereof, environmental sustainability is stated to be a driver of efficiency innovations, were one example of an incremental innovation is improving efficiency, thereby contributing to environmental sustainability with waste management. Consequently, environmental sustainability is not

necessarily only a driver of creative destruction of businesses but can be recognised as a contributor of change regarding how business processes and operations are constructed, instead of rationalising an extension of the definition of the market.

6 Conclusions

6.1 Research Aim and Objectives

Corresponding to the aim of the research, two environmental sustainability innovations within the upstream instances of the U.S. dairy value chain were identified in this study. These seemingly rooted in a mission-driven approach concentrated around the trend of environmental sustainability. This global phenomenon combined with the emerging macro trends of veganism and sustainable living contributed to the introduction of plant-based and cellular agriculture innovations, which consequently formed the leading cases in this research.

Subsequently, and adhering to the research purpose, the two cases were analysed in terms of its type of innovation and disruption potential. Respectively, *plant-based innovation* was characterised as an alternative to dairy products in the form of a high-value product with a premium price. The innovation itself was initially considered as a business model innovation that disrupted the dairy market to a certain degree when firstly introduced, but is now categorized as an incrementally adopted innovation expanding businesses offerings. Consequently, the initial innovation possessed a disruption potential to a specific degree of the market in theory but has formed and remained a niche market. In contrast, the innovation of *cellular agriculture* is perceived as a substitute for dairy that aims to directly compete in price and product attributes as it replicates the taste and nutritional value of the product. In addition, the research has categorized cellular agriculture as a technological innovation since it fulfills a similar need as dairy. As a result, cellular agriculture innovation has a stronger potential to disrupt the market and to substitute a larger share of the market.

Lastly, the business implications for upstream actors within the dairy industry were analysed. The realised effects for *plant-based innovations* are similar to the theoretical implications

discussed, as the innovation only yielded a niche market and did not disrupt any actors but instead extended the market. Nevertheless, the innovation replaces the need for livestock farming, hence traditional farmers are affected the most, however not creatively destructed. In contrast, *cellular agriculture innovations* in dairy are currently emerging in form of a protein that enables B2B collaboration and thus discloses opportunities for processing firms, where larger firms have a resource and scale advantage compared to small or medium enterprises. In theory, this innovation entails that farming and transporting becomes obsolete due to delocalised production and a new value chain instance. In practice, however, a full disruption of the dairy players is only possible to a certain extent as dairy is perceived to be an ever-existing product. Lastly, the increased competition in combination with environmental sustainability driving efficiency within the value chain, caused the inability of small farmers to compete with large farmers before the entry of the innovations. Consequently, the two cases contribute to this creative destruction of small farmers. Furthermore, Environmental Sustainability has been initially identified as the driver of the two case innovations. However, it became apparent that it can be more perceived as the underlying mission-driven factor and a positive by-product, while the core driver of both innovations is to generate profit. However, a strong relationship between Environmental Sustainability and Efficiency has been identified, in which the former drives the latter. As a consequent both dairy and non-dairy companies are continuously and incrementally integrating efficient processes as a means to stay competitive. Corresponding to this and the commercialisation of new innovations, it became apparent that the more disruptive the innovation is the more incremental improvements are required to maintain a competitive position to adhere to economies of scale.

This research concludes that both of the examined innovations have the initial characteristics of a disruptive innovation, however their realised disruption effect is significantly different. Thus, while cellular agriculture has the ability to *disrupt*, plant-based innovation is currently rather *disturbing* the dairy industry. Consequently, the study illustrates that various types of innovation, such as business-model or technological, can have different *effects* on the value chain. Thus, the realised effects of innovations depend on the disruptiveness of its characteristics. Therefore, the differentiation between the types of disruptive innovation is crucial when predicting its effect on a value chain. Therefore, this research has provided theoretical implications opting for a vast

distinction of disruptive potential and realised disruption. On this note, it is important to also recognise the difference between *disturbing* and *disrupting* a market. Hence, innovations with lower disruptive attributes are disturbing market conditions, while innovations with higher disruptive attributes are disrupting. Therefore, this research categorized *disturbing* as shaking up the market and allowing the introduction of new alternative niche markets. In contrast, *disrupting* is crucially affecting the actors within a value chain in such a way that they are replaced our pushed out of it. Thus, disruption entails outcompeting several actors within a value chain but it does not necessarily equal creative destruction, indicating that the initial industry structure becomes obsolete.

Conclusively, this research broadens and extends the current literature of disruption, indicating that high-value can be characterised as disruptive, however their realised effect disturbs rather than disrupts the market. Furthermore, disruptive innovations can be considered as disruptive even if they do not creatively destruct the whole market but only one or more actors of the value chain. Lastly, innovations can have the attributes of a disruptive innovation but their realised effects are only disturbing the market.

6.2 Practical Implications

While this study is concentrated around the dairy industry, the concept of environmental sustainability is a phenomenon affecting industries on a global scale. Hence, non-energy efficient countries that are typically characterised by old market structure, traditions and path dependencies are confronted with the need for progress and efficiency. While efficiency is usually characterised by incremental developments, true change is fueled by radical changes. Thus, the need for changing innovations is not only concentrated around the subject of dairy but also concerns a broader scope of the industry. Consequently, the linkages between the different concepts of this study can not only be applied to the dairy industry but are also generalisable to a larger context, such as the packaged food industry. In fact, similar issues or movements such as increasing veganism are also affecting other food industry such as the meat and livestock industry. These are industries that are interrelated to dairy in many aspects, such as being inert

global industries producing high emissions and waste. Thus, innovations in the area of artificial reproduction of livestock products are not solely affecting dairy industries but also other livestock and food areas that include meat, eggs, milk, fur or leather. Hence, the impact of these developments could be generalised to industries outside of the area of food, such as fashion, furniture and even automotive. Therefore, this study can be analytically generalised to industries categorised by large waste and high emissions, thus facing similar environmental sustainability challenges. Furthermore, the given findings are also generalisable to developed countries and industries due to the similarity of apparent issues to the U.S.

Another practical implication is the actual future of traditional dairy apart from the theoretical conclusions. As previously highlighted, disruptive innovations do not necessarily lead to the creative destruction of a market. Whilst theory in general presents disruption as a threat to an industry, this research on the contrary examines that disruption can also be utilised as an opportunity. Due to the acknowledged dairy fixation, and the findings available from this study, it is unlikely that dairy will be completely replaced by innovations and is instead likely to exist in the future. Nevertheless, a full disruption of the whole dairy industry is possible if the generational change continuous to influence consumers attitudes towards dairy. However, the changing market environment could also lead to a potential diversification of different markets, implying that there is room for both dairy and dairy innovations to grow.

6.3 Research Limitations

Following the concluding discussion on how this research fulfilled its aim and objective are the research limitations. Firstly, one needs to acknowledge the difficulties of analytical generalisation. By studying one already established innovation within the market and another one that is preparing for its market entry, the study was provided with nuanced dimensions when discussing disruption potentials. However, as the commercialisation of cellular agriculture is yet to come only a theoretical analysis and conclusions for the innovation can be supported. Nevertheless, valid assumptions are used to predict practical implications.

Considering the identified conceptual linkages in this study, it is acknowledged that the literature review only covers two distinctive types of innovations, disruptive and incremental. Consequently, it is recognised that there are several other innovations encompassing other implications for an industry value chain. Thereof, this study cannot propose a full coverage of the dairy industry implications from all environmental sustainability innovations. Moreover, it is accepted that innovations other than the two case studies, can also affect the disruption potential and realised implications on a value chain. This limitation originates in the fact that there are several more innovations occurring in the U.S. dairy industry apart from plant-based and cellular agriculture. These realistically also encompass other types of potential implications, which may or may not be disruptive. Hence, this study does not set out to cover all aspect of all innovation's disruptive impacts on the industry value chain but was instead focused on the most concerning ones. Moreover, due to the limitations to solely analyse the upstream value chain, this research can neither be said to cover all realistically effects for different actors, since it is bound to affect downstream as well. Nevertheless, this has been highlighted in the initial research delimitation entailing that the aim and objective of this particular study were met.

Moreover, aiming at expanding an already elaborated and complex theory such as disruption is an ambitious motive. Therefore, acknowledging the very nature of a complex phenomenon, entails that one sole definition may be difficult to reach. Thus, adding upon the theory of disruption requires additional in-depth study. Hence, the findings presented in this study are broadening and extending the theory but need to be carefully tested to achieve a generalisability.

6.4 Future Research

The theoretical implications of this research are bound to the theory of disruption. Thus, the crucial differentiation between the terms *disrupting* and *disturbing* a market encompasses important implications for future research. Conclusively, future studies involving further analysis of this finding are needed to increase the legitimacy of this research. Hence, in order to complement and confirm this research and subsequently strengthen the given conclusions, extensive studies within the same or different industry are required. As previously said, a

generalisation to packaged food industries or other high emission-related industries is possible but requires additional in-depth studies. Furthermore, since the concept of disturbing was an inductively extracted finding of this research, it is crucial to further inductively approach this term in order to generate a theory complementing or contracting to the theory of disruption. Hence, the concept could either complement disruption in the sense of being a sub-term within the theory or it could generate a theory of its own in the context of realised effects from innovations.

Respecting analytical generalisation, future research is also suggested to encompass a more extensive study in regard to comparing implications for the dairy industry in several countries, to both, identify similarities and differences in the factors affecting disruption. Furthermore, it is of interest to use several more studies to test the conclusion that high-value innovations can encompass a certain disruption potential. Therefore, it is necessary to investigate if this phenomenon is bound to the specific industry of dairy or if it could be generalized in a broader context as a cause of environmental sustainability. This is connected to studies from the impact of generational change and an increased willingness as well as the ability to pay for high-value products.

Furthermore, assessing the sustainable friendliness of the emerging and growing industrial production of food and its relation to creatively destructing small farmers would be an interesting edge to a study. This research concludes that large farmers are pushing small farmers out of the traditional dairy industry. While this is supported in terms of environmental sustainability, since the large farmer is more equipped to mitigate waste management issues due to a resource advantage, this can be further studied with a thorough focus on the theory of Creating Shared Value (Porter & Kramer, 2011). Thus, it is of interest to study the social and ethical view of sustainability, and how the creative destruction of small farmers corresponds to this.

Further research also proposes to incorporate the consumers as the unit of analysis. In this study, it is acknowledged that the consumer plays a large role in the realised effects of the two innovations in terms of adoption rates and the corresponding market share. Additionally, the consumer plays a vital role in the emergence of the global issue of environmental sustainability.

Therefore, a study incorporating a downstream value chain perspective of the consumer and its power to demand the introduction of new innovations would be value adding.

Conclusively, it would be of interest to, in ten years time, glimpse back at this study and assess how the industry and its innovations developed. Thereof, an examination of whether plant-based innovations are still perceived as an alternative, if cellular agriculture evolved into a mainstream product and if the proposed implications on the value chain were realised is an appealing field of study.

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8 Appendices

8.1 Appendix A

8.1.1 Interview Guide: Perumal Gandhi

1. Can you tell us about Perfect Day?
2. What does Perfect Day want to contribute to?
3. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?
4. What is the difference between Perfect Day's innovation and plant-based alternatives?
5. What is your perspective on the development of the dairy industry from 2030 onwards?
6. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
7. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/willingness to pay?
8. How will the value and the volume of dairy products develop in your opinion?
    a. is there a future for dairy?
9. Do you think that certain steps within the dairy value chain become obsolete? If so, which ones? (Farming, Transporting, Processing, Distributing, Retailing, Consuming)?
    a. Or do you think the VC mention above will change in other ways?
10. How is the policy or regulation climate for your organization?

8.1.2 Interview Guide: Pete Pearson

1. Is it okay for you if we record this interview?
2. How does WWF contribute or respond to the sustainability challenges?

3. How do the US/Washington office approach it?
4. Are you active in the area of dairy related issues, such as C02 gas emissions, milk overproduction?
5. Are the challenges influencing environmental friendly businesses?
6. You are specialized in food waste, what does this entail? Can you maybe elaborate a bit on the concept of food waste?
7. What needs to be done, in WWFs point of view, to tackle the sustainability challenges ahead?
8. What is your thought on factory farming vs small farming?
9. How much innovation does food waste reduction require? Can you tell us about those?
10. What is your thoughts about the emerging food technology in the U.S. dairy sector? Such as more radical one's like artificial production of dairy?
11. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?
12. What is your perspective on the development of the dairy industry from 2030 onwards?
13. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
14. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/willingness to pay?
15. How will the value and the volume of dairy products develop in your opinion?

8.1.3 Interview Guide: Mark Cooper A

1. Is it okay for you if we record this interview?
2. From your point of view, what are the most concerning/prioritized technological and social innovations in the dairy sector?
    1. what role do they play and is that role vital in the future?
    2. how do you see the future of dairy?
3. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?

4. What needs to be done, in your point of view, to tackle the sustainability challenges ahead?
5. What is your perspective on the development of the dairy industry from 2030 onwards?
6. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
7. What crops is suitable for the US?
8. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/willingness to pay?
9. What is your thoughts about the emerging food technology in the U.S. dairy sector? such as more radical one's like artificial production of dairy?
    1. is that the future?
10. How will the value and the volume of dairy products develop in your opinion?
11. Do you think that certain steps within the dairy value chain become obsolete? If so, which ones? (Farming, Transporting, Processing, Distributing, Retailing, Consuming)?
    1. Or do you think the VC mention above will change in other ways?
12. How is the policy or regulation climate for green gas mitigation in California according to you?

8.1.4 Interview Guide: Tobias Linné

1. Is it okay for you if we record this interview?
2. From your point of view, what are the most concerning/prioritized technological and social innovations in the dairy sector?
    1. what role do they play and is that role vital in the future?
    2. how do you see the future of dairy?
3. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?
4. What needs to be done, in your point of view, to tackle the sustainability challenges ahead?
5. What is your perspective on the development of the dairy industry from 2030 onwards?

6. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
7. What crops is suitable for the US?
8. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/ willingness to pay?
9. What is your thoughts about the emerging food technology in the U.S dairy sector? such as more radical one's such as artificial production of dairy?
10. Have you heard about food technologies starting its value chain on the processing step, not using crops or cows?
11. How will the value and the volume of dairy products develop in your opinion?
12. Do you think that certain steps within the dairy value chain become obsolete? If so, which ones? (Farming, Transporting, Processing, Distributing, Retailing, Consuming)?
    1. Or do you think the VC mention above will change in other ways?
13. How is the policy or regulation climate for green gas mitigation in California according to you?

8.1.5 Interview Guide: Kate Krueger

1. Is it okay if we record?
2. Can you maybe elaborate a bit of what you are currently doing?
3. We saw that you're also involved with Perfect Day, what is your thought about their innovation?
4. What needs to be done in the U.S. dairy industry to address environmental sustainability challenges?
5. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?
6. What does the future of cellular agriculture look like?
7. What is your relation is to Perfect Day? and the their innovation?
    1. how big is the change they can bring?
    2. what does it constitute of?
    3. when is it likely to occur?

8. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
9. Who is the winner and losers? (obsolete VC steps?)
10. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/willingness to pay?
11. What will the funding for cellular agriculture in the future look like?
    1. who will fund? private or state (public)? - benefits of non-profit or not?
    2. in what will one invest in? dairy, meat, other?
    3. what will New Harvest look to invest in? what actors? or invest in the technology of cellular agriculture?
12. How is the policy or regulation climate for green gas mitigation in California according to you?

8.1.6 Interview Guide: Ludwig Bengtsson Sonesson

1. Is it okay if we record?
2. Can you elaborate on what you do?
3. Can you tell us about Project REINVENT?
    1. especially in terms of dairy (decarbonisation innovations)
4. Have you witnessed that the change towards environmental sustainability has affected your organization or your line of work? If yes, what has changed?
5. What needs to be done in the U.S. dairy industry to address environmental sustainability challenges?
6. Who is responsible for the change?
7. Is the consumer educated? is the industry educated?
8. What role does the non-profit org have?
9. What is your view on Factory farming?
10. If you divide the different innovations/initiatives to address the environmental challenges with in three areas: which one do you put most faith in, and which one is most plausible to increase/be dominant within 10 years?
    1. disruptive technologies and innovations in processing

2. plant based alternatives, product innovation
3. waste management across the VC (is this connected to decarbonisation innovations?)

11. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
12. Who is the winner and losers? (obsolete VC steps?)
13. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/ willingness to pay?

8.1.7 Interview Guide: Shashank Gaur

1. Is it okay if we record?
2. Can you tell us a bit about your role at Elmhurst Milked?
3. Do you consider Elmhurst Milked as a frontrunner, that opened up opportunities for other companies to do the same?
4. What will be the consequences for the farming instance in the VC? losers? what is the use of cows?
5. What did the change from dairy to non-dairy entail? How hard was it?
6. What are further innovation in the dairy sector look like?
7. What is the future of plant based alternatives?
8. What crops is suitable for the U.S.?
9. What does the future of the dairy industry look like in your opinion?
10. Have you heard about food technologies starting with its value chain on the processing step, not using crops or cows?
11. Do you think that dairy alternatives will take over the traditional factory farming in the U.S.? When and how do you think this change may occur?
12. Is there a future for cellular agriculture in plant based milks?
13. What needs to be done in the US dairy industry to address environmental sustainability challenges?
14. Who is responsible for the change?
15. What role does the non-profit org have?

16. Is the consumer educated? is the industry educated?
17. Who is the winner and losers? (obsolete VC steps?)
18. How do you perceive the development of the future of farming, both crops and livestock, considering the wants and needs of the customers/willingness to pay?
19. If you divide the different innovations/initiatives to address the environmental challenges with in three areas: which one do you put most faith in, and which one is most plausible to increase/be dominant within 10 years?

8.1.8 Interview Guide: Mark Cooper B

1. Is it okay if we record?
2. Can you maybe tell a bit about what happened in the U.S. concerning the dairy and dairy alternative market?
3. Where did the alternatives, firstly plant based and secondly cellular agriculture, come from?
4. Do you see a consumer pull or a push from firms?
5. What is your thought on innovations on an inert market, such as the dairy market, in a developed country such as the U.S.?
6. What is disruption in your opinion? What is a disruptive innovation?
7. In your view can innovation be disruptive even though they don't have the characteristics of disruptive products (low price and reaping large market share)?
8. Looking to innovations on an inert market such as the U.S. dairy industry, what impacts can they actually realise?
9. How far is the disruption of the dairy market right now? Is there a disruption?
10. What are the strategic or business implications for actors on the market?
    1. specifically, an incumbent firm?
    2. also, what has been needed for new entry firms to survive?
11. What role does environmental sustainability have in all of this?
    1. innovation due to this or is it a positive consequence of new innovations?

12. Is there a shift towards creating superior value instead of easy, cheap alternatives? e.g. environmental sustainability

8.1.9 Interview Guide: Todd Hutson

1. Is it okay if we record?
2. Can you maybe tell a bit about what happened in the U.S. concerning the dairy and dairy alternative market?
3. where did the alternatives, firstly plant based and secondly cellular agriculture, come from?
4. Have you witnessed any changes in the dairy industry in the recent years?
5. How can companies stay competitive in a changing environment?
6. Do you see a consumer pull or a push from firms?
7. Premium products (plant based), what role does price play?
8. What is your thought on innovations on an inert market, such as the dairy market, in a developed country such as the U.S.?
9. What do you think are the dairy companies' strongest competitors right now?
10. Plant-based= alternative, cellular agriculture= substitute, what's your opinion?
11. What kind of impact do cellular agriculture innovations have on Tetra Pak?
12. What are the strategic or business implications for actors on the market?
13. What impact could changes in the U.S. dairy industry have on farmers?
14. Is there a shift towards creating superior value instead of easy, cheap alternatives? e.g. environmental sustainability
15. Is there an innovation limit in dairy?

8.1.10 Interview Guide: Lloyd Metzger

1. Is it okay if we record?
2. Can you maybe tell a bit about what happened in the U.S. concerning the dairy and dairy alternative market?

    1. where did the alternatives, firstly plant based and secondly cellular agriculture, come from?
3. Have you witnessed any changes in the dairy industry in the recent years?
4. What is your opinion about plant-based alternatives?
5. Will traditional dairy prevail?
6. How can companies stay competitive in a changing environment?
7. Do you see a consumer pull or a push from firms?
8. Premium products (plant based), what role does price play?
9. What is your thoughts on cellular agriculture innovations?
10. What do you think are the dairy companies' strongest competitors right now?
11. Plant-based= alternative, cellular agriculture= substitute, what's your opinion?
12. What are the strategic or business implications for actors on the market?
13. What impact could changes in the U.S. dairy industry have on farmers?
14. Is there a shift towards creating superior value instead of easy, cheap alternatives? e.g. environmental sustainability
15. Is there an innovation limit in dairy?

8.2 Appendix B

8.2.1 Atlas TI: Code Group Overview

- ”DA” = Dairy Alternative
- *D* = Dairy
- *D+A*= Dairy and Alternatives
- *E*= Efficiency

"DA": Cellular Agriculture

13 Codes:

○ Cellular Agriculture= delocalizes production

○ Cellular Agriculture= growing

○ Cellular Agriculture= immediate disruption potential

○ Cellular Agriculture= meets future expectations of customers

○ Cellular Agriculture= more control of outcome

○ Cellular Agriculture= sterile process

○ Cellular Agriculture= substitute

○ Consumer interested in premium = not equal consumer with environmental concern

○ Consumer power > political power

○ Consumers: price= no factor of not to switch

○ Dairy Alternative: Slow growth

○ Regulation Cellular Agriculture: difficult (for meat)

○ Regulation Cellular Agriculture: protein products, solved

"DA": Dairy Alternative

37 Codes:

○ ALL INNOVATIONS: Importance of Economies of Scale

○ Allergen Market

○ Competition between dairy alternatives

○ Competitive Advantage for Dairy alternative

○ Competitive Advantage for Dairy alternative: Unique value

○ Dairy Alternative

○ Dairy Alternative Market Leader: Oatmilk

● Dairy Alternative: 15% of the market

○ Dairy Alternative: Alternative or Substitute

○ Dairy Alternative: Consumer Experience, negative effects

○ Dairy Alternative: Costs of upstream inputs

● Dairy Alternative: Established Product

○ Dairy Alternative: higher price

● Dairy Alternative: higher value

● Dairy Alternative: Mainstream (not significant though)

○ Dairy Alternative: more sustainable (only plants)

○ Dairy Alternative: Need for differentiation

○ Dairy Alternative: Need for new marketing campaign

○ Dairy Alternative: Potential for most environmental product

○ Dairy Alternative: Slow growth

○ Dairy Alternative: Tradeoffs between different types

○ Development of organic products

○ Driver of Switching: Alternatives are perceived as healthier

- Increased Consumption: Milk Alternative

"DA": Elmhurst Business Model

10 Codes:

- Elmhurst Business Model
- Elmhurst Business Model: high value products
- Elmhurst Business Model: inhouse recycling
- Elmhurst Business Model: Sustainably Sourced
- Elmhurst Competitive Advantage: Diversification of products
- Elmhurst Consumer: Vegan, plant-based, high value
- Elmhurst, Plant-based Innovation: more nuts per drink
- Elmhurst= Unique Case Example
- Plant-based innovation: clean milk, Elmhurst
- Plant-based Innovation: No Emulsifier, Stabilizer, Elmhurst

"DA": Hybrid Product

5 Codes:

- Hybrid Product: Plant-based + Cellular agriculture
- Hybrid Products: low potential
- Innovation: Hybrid Dairy Products
- Innovation: Hybrid Products

"DA": Milk Protein Innovation

34 Codes:

○ B2B Ingredient Company

○ Business Acquisition: Incumbent buying disruptive product

○ Flexibility

○ Innovation for No suitable dairy environment

○ Milk Innovations in 20 years: attractive for large parts of the population

○ Milk Protein Innovation

○ Milk protein innovation, Challenge: Easy repeatable

○ Milk Protein Innovation: Consumer that switched to vegan

○ Milk Protein Innovation: Consumers, vegan vs. vegetarian

○ Milk Protein Innovation: High Potential

○ Milk Protein Innovation: Investments for Infrastructure needed

○ Milk Protein Innovation: Milk Ingredient Product

○ Milk Protein Innovation: Need for societal change

○ Milk Protein Innovation: Nice Product

○ Milk Protein Innovation: Niche Product at first

○ Milk Protein Innovation: No Upstream Investment= Slows development down

○ Milk Protein Innovation: Perceived as ready for the market

○ Milk Protein Innovation: Potential to Change Market

○ Milk Protein Innovation: Requires big company investments

○ Milk Protein Innovation: Substitute

○ Milk Protein Innovation: Succesful if taste is re-created

○ Superior Nutritional Value

"DA": Plant-based innovation

13 Codes:

○ Dairy Alternative Crops: high value

● Elmhurst, Plant-based Innovation: more nuts per drink

○ Losers: initial Plant-based companies unable to compete

● Nut Products: limited premium niche

● Plant-based innovation: Alternative, not substitute

○ Plant-based innovation: awareness of nutritional value is emerging

● Plant-based innovation: clean milk, Elmhurst

○ Plant-based innovation: enough if carbon/emission is negaitve

● Plant-based Innovation: No Emulsifier, Stabilizer, Elmhurst

● Plant-based innovation: Shaked up the market

○ Plant-based: easy switch

○ Plant-based: utilise to local resources

○ Substitute= Products with similar characteristics

D: Big Farmers

13 Codes:

○ Big Companies: perceive innovation as threat

○ Big Farmers: Incremental transition

○ Creative Destruction: Big Productions undermining small ones

○ Currently: Big Farmers surive due economies of scale

● Farmers preserve status quo

● Farmers: unable to change due to investments

○ High Scale= Efficiency

○ Large companies can influence agriculture lobby

○ Losers: Big companies unable to capitalize on storytelling

● Losers: Farmers not able to react

● Losers: Farmers Unwilling to Change

○ Majority Large Farmers

○ Opportunity for Dairy Industry Leaders/Giants

◈ ***D*: Dairy Fixation**

9 Codes:

○ Dairy Fixation

○ Dairy in lots of products

○ Food Industry: Conservative

○ Government US= Problem rather than driver of change

○ Preserving Pasture land: requires 30% of current amount of cows

○ Problem: Bottom 20% resistant to Change

○ Resiliency

○ U.S. is their own biggest issue

○ U.S.= Disturbing Change

◈ ***D*: Dairy Industry**

38 Codes:

○ Dairy Challenge: Creating new way of consuming dairy

○ Dairy Fixation

○ Dairy in lots of products

● Dairy Incremental Innovation: Clean Label

○ Dairy Industry: Controlling nations through powdered milk

○ Dairy Industry: Focus on Nutritional Sustainability > Greenhouse Gas Emission

○ Dairy Industry: includes Meat industry

● Dairy Industry: New ways of selling the same product

○ Dairy Industry: protected by big national interests

○ Dairy is a By-product itself

○ Dairy Trend: Higher protein

● Dairy will always exist

○ Dairy: less sustainable (Cow+feeding)

○ Different brands with similar products

○ Diversification of the Dairy Industry

○ Innovation Limit of Dairy

● Interest in sustainability is growing

● Milk Consumption Decline

○ Milk used for Byproducts

○ Opportunity for Dairy: Storytelling

○ Opportunity of Dairy: Niche Markets

● Perception of being environmental friendly

◈ ***D*: Small Farmers**

12 Codes:

● Farmers preserve status quo

● Farmers: unable to change due to investments

○ Growth of regional, small farmers

○ Ideally: Environment for Small Farmers to Survive

- Losers: Farmers not able to react
- Losers: Farmers Unwilling to Change
- Losers: small scale farmers
  - Shift in production for organic p.: from small to big farmers
- Small Farmers Niche Market: not possible on a large scale
  - Small Farmers: Easier transition
- Small Farmers: minority, but higher value, more sustainable
- Winners: Small Premium Farmers

◈ ***D+A*: Co-opting**

10 Codes:

- Co-opting
- Co-opting disruptive innovations
- Co-opting disruptive innovations: for large companies to protect themselves
- Co-opting disruptive innovations: opportunity for innovation drivers
- Consolidation of growth for big and small farmers

◈ *E*: Waste Management

24 Codes:

- Avoiding loss on consumer's end
- Ensure Zero Loss
- Transparency
- Improving Efficiency= Narrow definition of sustainability
- Innovation Limit of Dairy
- Locating Losses
- Manage manure: easier challenge

○ Matching Demand and Supply

○ Measuring Waste, Improving Efficiency= not enough

○ Overproduction: Intriguing Problem

○ Waste on Consumer Side

○ Waste= Most resource inefficient

○ Zero Tolerance

○ Zero Waste

Big Farmers: more efficient

1 Codes:

○ Big Farmers: more efficient

Decentralization

6 Codes:

○ Centralization of Farming

○ Innovation: Local Niche Model

○ Need: Decentralization and localized products

○ Plant-based: utilise to local resources

○ Prediction (Tobias): localized production

○ Threat for centralizing farming: Availability

Disruption in Dairy

36 Codes:

○ Disruption #1 opening need for alternative market

○ Disruption #2: Fundamentally changing the market

Environmental Role

8 Codes:

○ Climate Issue more threatining vs environmental issue

○ Environment: Driver of Switching

○ Environmental Footprint vs. Greenhouse Gas Footprint (harder)

○ Environmental Sustainability: Impacts the whole value chain

○ Evaluating environmental impact: difficult

○ Sustainability Benefits

○ Sustainability Discussion: Increased heard sizes

○ Two-Way Path: Environmental Sustainability driving Innovation; Innovation driving ES

Generational Change

2 Codes:

○ Generational Change: Accepting Alternative as normal product

○ Generational rather than personal change

Greenhouse Gas Emission

7 Codes:

○ Grazing in Pasture=more methane

○ Greenhouse Gas Emission= Fundamental process within animal

○ Greenhouse Gas Emissions: not known how to manage

○ Less Processed Feed= More Methane

○ Low Carbon Footprint

○ Priority 2: Greenhouse Gas Emission; Production Efficiency

○ Underlying Challenge: Greenhouse Gas Emissions

Industrial Production

3 Codes:

○ Adjust Production

○ Industrial production= solves geographic challenge

○ Replacing natural production processes with industrial

Regulation, Government, Location

40 Codes:

○ Dairy Pride Act: Reaction from a freightened industry

○ East&West Coast vs. Middle States (hard to transition)

○ Glut: prices decline, People lose money, decline in market share, production declines

○ Government Funding: needed

○ Government US= Problem rather than driver of change

○ Government: big influencer of sustainable change

○ Government: both opportunity and barrier

○ Government: Slow, Incremental Change

○ Governmental Climate Plan

○ Incorporate Tax Money to transition

○ Innovation Driver: California