The Stories of Swedish Edible Insects Entrepreneurs
Activities, Business Models, and TIS Evolution

Chattraporn Chatthong
Abstract

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Sustainability transition has gained more interest in academic research. However, it has rarely been studied specifically from a firm-level perspective. Therefore, this study aims to understand and learn from the firm-level perspective to contribute to firm- and system-level understanding. The case study of insects as food and feed industry is interesting in a niche and challenging market or to understand the overcoming activities of those facing barriers, whether the overcoming of customer acceptance, uncertainty of the market, and the regulations of eating insects as just been approved by the European Commission in recent years. Moreover, the study of insects has been widely focused on entomology, such as species, and nutrition. It is beginning to be studied in the food sector in Western countries, recently. Therefore, this research will contribute an in-depth understanding of the firm-level in the edible insect industry, especially in the business section in Sweden.

This research contributes to the understanding of entrepreneurs' sustainable business models in different time periods, which could be shaped by barriers and opportunities. The barriers found in this study are similar to previous studies of the insect industry in other countries, except for customer acceptance, which seems to be different in Sweden. The customer issue that stands out here is finding the niche group of customers and the niche product that suits these early adopter customers. I also found the importance of entrepreneurial activities in relation to the development of the technological innovation system (TIS). The actors or entrepreneurs are the catalysts for the development of the TIS in the uncertain industry, since every single movement of the entrepreneurs leads to the dynamics of the system, such as a lobbying activity to overcome the regulatory barrier.

Keywords: sustainable entrepreneurship, entrepreneurial activity, sustainable business model, technological innovation system (TIS), insect entrepreneur, alternative protein, sustainable food
Popular Scientific Summary

Insects have recently been recognized as a novel food source for humans in the European Union, although they have a long history of consumption in the Eastern world, particularly in countries such as Thailand, Vietnam, China, and India. Academic research has shown that insects are highly nutritious, rich in protein, and contain essential amino acids necessary for human health. In addition, insect farming is considered to have a low carbon footprint and requires less food and land than other protein sources. For these reasons, insects are increasingly recognized as a promising alternative protein option.

However, insect consumption is still relatively uncommon in European Union countries, including Sweden. This research seeks to uncover the history of the edible insect in Sweden, which mainly focused on the business sector, to understand the activities involved in this industry and to identify the barriers and opportunities specific to Sweden, as well as similarities and differences compared to other EU countries. In doing so, we aim to shed light on the current state and potential of the edible insect market in Sweden. The mentioned activities are delivered in the storytelling of each company and narrowed down to sustainable business models. Next, the research also shows the analysis of how the firm-level activities influence the change at the system level.

This research aims to enhance our understanding of the firm-level perspective in the study of sustainability transitions, with a specific focus on the technological innovation system (TIS). The existing literature in this field has paid limited attention to the firm-level perspective, creating a gap that this research seeks to address. By examining the firm-level dynamics within the context of the sustainability transition, this study will contribute to filling this gap and emphasize the significance of system-level actors in the industry. Lastly, the research provides suggestions for the policymakers which could a small part to help develop the edible insect industry in Sweden, especially in the business sector.
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Thank you all for being part of this incredible journey,

Chattraporn Chatthong (Joy)
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1 Introduction

In the study of sustainability transition, with a particular focus on the technological innovation system (TIS), little attention has been paid to the existing literature in this area of the firm-level perspective, leaving a gap that this study aims to fill. This study will contribute to filling this gap by analyzing firm-level dynamics in the context of sustainability transition and highlighting the role of system-level actors in the sector.

Moreover, sustainable entrepreneurship has gained prominence as a key driver for promoting a more environmentally and socially responsible economy. This study aims to investigate the motivations and activities of sustainable entrepreneurs in the Swedish edible insect industry and how these factors change at different stages of business development. By exploring the links between entrepreneurial goals, activities, sustainable business models, and the technological innovation system, this research contributes to our understanding of sustainable entrepreneurship in emerging and niche markets. Given the environmental benefits of insect protein, it is important to examine the role of business in advancing this industry.

The choice to focus on the edible insect industry in Sweden is motivated by the increasing global demand for alternative protein sources and the potential of this sector to contribute to a more sustainable food system. While insects are consumed in various regions of the world, it is still a novel concept in European countries, including Sweden. As a result, the industry faces several challenges, such as customer acceptance, regulatory hurdles, and scaling up production.

Through this research, I will analyze the motivations and activities of entrepreneurs operating in this niche market and explore how they overcome the various barriers and challenges that arise at different stages of business development. Furthermore, this study aims to provide valuable insights into the dynamics of entrepreneurial decision-making in the face of uncertainty and barriers to market entry, and their influence on the development of sustainable business models and the broader technological innovation system in the Swedish edible insect industry. This contribution of two frameworks strengthens the theoretical and empirical basis of sustainability transition and sustainable entrepreneurship.

The report proceeds as follows: the first section summarizes includes the motivation and, problematization, and addresses presents the research questions. In Section 2, the literature reviews and the theoretical frameworks applied in this research will be described, i.e., sustainable entrepreneurship, business model innovation, and technological innovation systems. The methodology is represented in section 3. In Section 4, the findings and analysis are written with a narrative writing so that the readers can follow the storyline of each entrepreneur. Finally, in Sectors 5 and 6 provide the discussion and conclusion of how the activities of sustainable entrepreneurs influence the emergence of this novel and niche market.
1.1 Motivation

As the world's population is increasing, so is the demand for animal protein. Unfortunately, traditional methods of animal protein production have caused significant biodiversity loss and environmental degradation. It is therefore important to explore new and innovative solutions that can meet our protein needs without harming the planet. When compared to other alternative proteins such as plant-based, cultured meat, and single-cell proteins through life cycle analysis (LCA), insects appear to have lower energy consumption, greenhouse gas emissions, and water usage per kilogram of the product (Hadi and Brightwell, 2021; Jansson et al., 2019 p.20). This makes insects as an alternative protein a viable option. Insects are seen as a promising solution to meet the growing demand for food, especially as traditional protein sources decline. Insects as food have been studied in several aspects (van Huis et al., 2013), such as environmental impact (Oonincx and de Boer, 2012), food security (van Huis, 2013), and customer attitudes (Roma et al., 2020; Collins et al., 2019). However, there are few numbers of business-related research studies concerning this industry. Therefore, this study could fill a research gap.

As the study is related to sustainability therefore the business-related research that is the focus of this study is the sustainability transition. Since the edible insect industry is still in an early stage and niche industry, there are not many actors involved. One of the most important actors involved in the sustainability transition in this alternative protein industry is the insect entrepreneurs, who have a great influence on scaling up production, as entrepreneurs are seen to have a higher motivation for new opportunities than the incumbents (Hockerts and Wüstenhagen, 2010 p.481). According to Hockerts and Wüstenhagen, entrepreneurs are more willing to change and more flexible than incumbents. They respond more quickly to new opportunities. Therefore, the approaches of entrepreneurs could lead to the development of this growing industry.

In Sweden, there are only a few insect entrepreneurs that have survived since the first boom in the 2010s. Most of the companies have left the industry. The entrepreneurial strategies of both existing and quitted companies may show differences between them. This leads to this research purpose, which aims to understand the sustainable entrepreneurial activities of existing and previous companies in this industry, in different phases of business development. It could help to differentiate the strategy and behavior of entrepreneurs in different situations.

1.2 Purposes and Research Questions

This study aims to understand entrepreneurial activities to gain insights into how companies operate at the firm level in the context of sustainability transitions. These activities are embedded in each firm's business model and can be categorized into three main components: value proposition, value creation and delivery, and value capture. In addition, the study will analyze the relationship between these activities and the opportunities and barriers perceived
by entrepreneurs over time. This analysis will not only improve the understanding of firm-level dynamics but will also enable us to see how firm-level actions contribute to systemic changes.

**Research questions**

- *How have the business models of Swedish insects as food and feed companies been shaped over time and about opportunities and barriers perceived by the entrepreneurs?*
- *How do entrepreneurial activities stemming from the business models drive the evolution of the Technological Innovation System in the Swedish insect-as-food industry?*

### 1.3 Scope and Limitation

The research was carried out through interviews with insect entrepreneurs in Sweden, where some companies are still in operation, while others have already closed down. In addition, the interviewees were asked about past events, which leads to forgetting and missing the timeline of the story. To mitigate the risks, I used secondary sources such as blogs and news that represent the event at a single point in time in the past to clarify the correct time and stories.

As a suggestion for future research, I would like to emphasize the limitations of this study. First, the research is based on a case study of Swedish insect start-ups. This may limit the generalization of these findings to other contexts or regions. Second, the data collected for this research is primarily based on interviews with entrepreneurs and company representatives. This may lead to misunderstandings or biased views. Future research could benefit from incorporating a wider range of data sources, such as the views of public and private organizations, to provide a more comprehensive picture. Finally, while the study ultimately identified three main barriers: regulation, customer acceptance, and finance, new barriers and opportunities may emerge in the future. Therefore, future research could aim to monitor the evolution of the industry and changing barriers.
2 Literature Review and Theoretical Framework

2.1 Literature Review

As the world’s population is increasing, so does the demand for animal protein. Unfortunately, conventional methods of animal protein production have caused significant biodiversity loss and environmental degradation. It is therefore important to explore new and innovative solutions that can meet our protein needs without harming the planet. Currently, although approximately 2 billion people worldwide include insects in their cultural diets, the insect-based food industry is still in its early stages. Although insects are considered traditional foods in many countries, they are now categorized as “novel foods” in the European Union. Most of the insect-based food companies in European countries, including Sweden, are start-up companies that have an average number of employees lower than 10 people. Most of them are producing and launching similar products which are still niche products, for instance, insect powder, and crispbread. So, the main challenge for start-up companies is to identify the target groups and selling points (van Huis et al., 2021; Reverberi, 2021).

Insect-based food and feed have recently grown in academic research globally, especially in Western countries, as a potential alternative protein (van Huis, 2013), a sustainable economic system, and a circular business model (Madau et al., 2020; Borrello et al., 2016). With the increasing population and the decrease in traditional protein sources, insects are considered a promising solution to meet the food demand in the future. The market surveys predict that there will be strong growth of the edible insect market in the next decade or two decades, and will reach USD 7.96 billion by 2030 (Reverberi, 2021; Meticulous Research, 2022). Also, some Swedish researchers support that insects as food could be one of the drivers of sustainable use of agricultural landscape, and decrease negative impacts, such as the level of pesticide use (Jansson et al., 2019).

As a potential alternative protein, Pleissner and Smetana (2020), for example, found that 0.06 kg of black soldier flies larvae (BSFL) can convert 1 ton of food waste into 60 kg of frass and 9.57 kg of larvae can be used as a sustainable protein source. Food waste is seriously treated when considering sustainability in the food system. Several researchers have studied alternative actions to reduce food waste, and some of them proposed that insect-based production could be a sustainable solution to reducing food waste (Cheng et al., 2017; van Huis and Oonincx, 2017). However, wastes from different types of food can be used by different insect species, for example, mealworms and some other species of insects grow better in dried waste material (Huis and Oonincx, 2017) while BSFL has a higher growth rate with wet waste (Cheng et al., 2017). Those studies show that insect-based production could reduce food waste. Additionally, left-over substrate and by-products from insect rearing such as chitin and lipids can be utilized for biodiesel and medicinal purposes. Farming insects as livestock seems to be a potential alternative protein for the food and feed industry. It is considered a candidate for remarkable growth and has the potential to bring significant benefits to the agri-food industry (Cadinu et al., 2020).
However, the insect-based food industry is still in its infancy and several challenges need to be addressed to ensure its long-term sustainability. The barriers and risks in the insect-based food and feed industry have been studied by Niyonsaba et al. (2022). The research findings show the barriers and risks which are divided into 4 areas, first is operational barriers and risks, second is financial, cost, and market barriers and risks, third is a worker and food safety barriers and risks, and forth is regulatory barriers and risks. The study shows that two of the three highest barriers for insect-based food companies in European countries are regulatory barriers, and another one is insufficient market demand. The highest barriers in the insect-as-feed industry are the high price of young larvae, followed by the legal restrictions concerning the use of insect meal in feed (Niyonsaba et al., 2022). As mentioned that the market of insect-based food in the world today is still facing many barriers, such as high levels of uncertainty in demand and supply, however, there are opportunities for early mover entrepreneurs to benefit (Lee et al., 2021).

In today's world, the concept of sustainable food is gaining importance, leading to the rise of 'sustainable entrepreneurs' who see this as a business opportunity (Perdomo, 2019). However, the appeal of these opportunities varies among entrepreneurs. The case of sustainable entrepreneurs in the insect-as-food industry was found in the study of Daub and Gerhard (2022). They conducted a study on Essento, an insect-based food company, and found that their vision of sustainability played a key role in their success as a business. The company emphasized the importance of adaptability and flexibility in the founding process and maintained a strong focus on sustainability and high-quality products. The founder of Essento, Christian Bärtsch, stated that being open and adaptable was crucial for their success, despite the challenges of navigating regulations (Daub and Gerhard, 2022). The study drew comparisons to Switzerland in terms of how edible insects have evolved from an infringement to a sustainable business model. As I see the lessons learned from Swedish companies and their paths can lead to an increased understanding which could contribute to existing knowledge from other countries in Europe.

2.2 Theoretical framework

To conduct a completed review of the literature on sustainable entrepreneurship in sustainable transition, a systematic approach was taken. The first step involved identifying key research questions that focus on the intersection of these two fields. The search was conducted using a combination of keywords including "sustainable", and "entrepreneur*". This ensured that all results related to "sustainable entrepreneur", "sustainable entrepreneurship", and "sustainable entrepreneurial" were captured. Moreover, I also sought articles related to “entrepreneur*”, and “transition”, to cover the aim of the research. To achieve this, Google Scholar was mainly utilized to search for relevant literature. Some of the literature was found by being mentioned in the previous literature or by citing the same literature I was reading.

Throughout the search process, focus words such as "niche level", "micro-level", "firm-level", "organizational level", and "new entrants" were kept in mind to ensure that the literature selected was most relevant to the aims of the study. I first read the abstract section in those
articles before deciding to download the full version to read them later. Therefore, not all the research found will be applied in the thesis.

Publications about sustainability transitions in the early phase were mostly related to electricity and transportation, while there is more diversity in other domains such as food, water, heat and building, and cities and waste management in recent years (Köhler et al., 2019). In the studies of sustainable transition, there are four often-used systematic frameworks: the Multi-Level Perspective (MLP), the Technological Innovation System (TIS), Strategic Niche Management, and Transition Management (TM) (Köhler et al., 2019). Although there are several types of frameworks in the sustainability transition, the underlying motivation of the studies is the same. All want to overcome the challenge of unsustainable consumption and production patterns in socio-technical systems (e.g., electricity, heat, and agro-food) (Köhler et al., 2019). The frameworks on sustainability transition can be complemented with different concepts to strengthen the theoretical and empirical basis of sustainability transition frameworks, such as the concept of sustainable entrepreneurship. The entrepreneur level or firm level is needed more attention in the study of sustainability transition. For example, some researchers stated that the concept of sustainable entrepreneurship remains as much of a ‘black box’ (Gibbs, 2006) where the sustainable development of firms is still ambiguous in how they achieve or connect to wider social changes. Examples of previous research on sustainable entrepreneurship integrated with sustainability transition frameworks are the concept of sustainable entrepreneurship integrated with MLP (Hörisch, 2015), and the concept of sustainable entrepreneurship integrated with TS (Gibbs, 2006).

In this study, the framework is built on sustainable entrepreneurship. The framework will lead to the understanding of the firm-level activities in the sustainability transition through its system components. By understanding the entrepreneurial strategies of entrepreneurs in the sustainability transition, we can better understand the mechanisms that influence the speed and direction of change at the system level in the future, e.g., we might be able to decide on better policies (Alkemade et al., 2011). In other words, entrepreneurial strategies may contribute to the fulfillment of the functions of the innovation system (Alkemade et al., 2011).

### 2.2.1 Technological Innovation System (TIS)

As I mentioned that this study of the activities in sustainable entrepreneurship combined with the framework of TIS to see if entrepreneurs, the so-called firm-level actors, affect the change or evolution of sustainability transition, so the understanding of this innovative system and its functions are necessary to be identified. Innovation systems in general consist of three components; actors, networks, and institutions (Bergek et al., 2008). The actors, which are also called components in the study of Carlsson et al. (2002), “are the operating part of the system…such as individuals, business firms, banks, universities, research institutes, and public policy agencies” or non-living things such as transformers, traditions, and social norms. Networks or relationships “are the links between the components”. The components are dependent on other components’ behavior or properties, so once a component changes or is removed from the system, the other components in the robust system will also change their
characteristics while the components in the non-robust would collapse if the important component is removed. Lastly, institutions “are the properties of the components and the relationship between them”, or in other words, it is capabilities of actors and relationship. (Carlsson et al., 2002 pp.234-235)

This study follows the steps drawn by Bergek et al. (2008). So, it means I first define the structural components of the study’s focal industry, then map the functional patterns. For example, entrepreneurial activities function to some extent influences the transition by overcoming uncertainties. However, the application of other functions will show in the following section. To conclude, the innovation system chosen to focus on in this study is the Technological Innovation System (TIS) which is one type of socio-technical system focused on particular technological uses, and the study case is a case of edible insect companies in Sweden.

Researchers identified seven key processes (or functions) that are important in emerging TIS frameworks. These processes include entrepreneurial experimentation/activities, knowledge development, knowledge exchange/diffusion, the guidance of search, market formation, resource formation/mobilization, and overcoming resistance to change (creation of legitimacy) (Bergek et al., 2008; Hekkert and Negro, 2009). To understand which system functions, turn out to be strong drivers and barriers for system change, Hekkert and Negro (2009) suggest a method to analyze as follows.

1. Entrepreneurial experimentation/activities: Entrepreneurial activities are a key indicator of progress in the TIS. They are critical for technology diffusion and play a central role in linking other system functions, which in turn contribute to virtuous cycles.

2. Knowledge development: Knowledge development is important in all cases, especially in the early stages of technology emergence when uncertainty is high. This function needs to be defined broadly to include knowledge about how new technologies work and perform, as well as knowledge related to generating insights about the fit between new technologies and existing business practices and regulations.

3. Knowledge exchange/diffusion: Knowledge diffusion is difficult to capture, but it is a critical function in the TIS. While the events in which knowledge diffusion is likely to occur can be measured, many knowledge exchange processes take place in dyadic relationships that are not reported in the literature.

4. Guidance of search: Search guidance is a critical system function that underlies many developments and leads to several courses of action. Strong guidance can motivate entrepreneurs to enter a new technological field and directly influence the number of resources allocated to knowledge development.

5. Market formation: Market formation is often adopted at an advanced stage of development, but it can significantly accelerate the early stage of the TIS. It is a critical system function that has a direct impact on system growth.

6. Resource formation/mobilization: Resource mobilization is relevant in every case study. Many knowledge development projects have been initiated through the
allocation of resources. However, it is difficult to mobilize resources to build and construct facilities, and both government and private investors are often reluctant to make the necessary investments.

7. Creating legitimacy: Legitimacy creation is a critical function that positively aligns institutions with the needs of agents in emerging innovation systems. The absence of this system function is often an indicator of a poorly functioning innovation system and a poor alignment between institutions and the needs of the emerging innovation system.

### 2.2.2 Sustainable entrepreneurship

Following the definition of Hockerts and Wüstenhagen (2010), ‘sustainable entrepreneurship is the discovery and exploitation of economic opportunities through the generation of market disequilibria that initiate the transformation of a sector towards an environmentally and socially more sustainable state’. Muñoz and Cohen (2017) categorized the research on sustainable entrepreneurship into four categories: actors (entrepreneurs), context, deal (outcomes and impacts), and opportunity. In this study, I focus on the actor level which covers individuals and companies, and the context e.g., the relationship with stakeholders. However, ‘Sustainable entrepreneurship’ has been defined into several meanings, but mostly based on a triple-bottom-line: economy, environment, and social aspects.

From my understanding, a ‘sustainable entrepreneur’ is an individual or a company whose set of ideas or mindsets is developed and led by sustainability. Scholars such as Schaltegger and Wagner (2011) defined sustainable entrepreneurs as actors and companies who make environmental progress to their core business. The mentioned progresses could be shown as a replacement of new products, services, techniques, and organizational modes that mitigate the environmental impacts but boost the sustainable quality of life (Schaltegger and Wagner, 2011). However, to evaluate someone as a sustainable entrepreneur, there are several aspects to think about. Walley and Taylor (2002) believe that motivation is one important inner aspect to think about, but it does not mean that the entrepreneur’s motivation has to be a solely but mixed combination of green, ethical, and social motives.

In previous studies, scholars divided the typology of sustainable entrepreneurs by the triple-bottom-line model, in which the definition of individuals is as in the above table (table 1) by Schaltegger and Wagner (2011). The types of this entrepreneurship depend on their main goals and core motivation. First, ecopreneurship focuses on earning money and solving environmental problems at the same time. Second, social entrepreneurship focuses on reaching a better society and gaining profit at the same time. Third, institutional entrepreneurship approaches the aim of creating new institutions. Lastly, sustainable entrepreneurship is the concept of an entrepreneur who focuses on both environmental and social aspects. (Schaltegger and Wagner, 2011)

One of the concepts most related to this case study is ecopreneurship. In ecopreneur's research, the ecopreneur is divided into many classifications by the interplay of their personal motivation or external factors (Gibbs, 2006). For example, there are classifications of ecopreneurs such as
Schaltegger (2002), and Linnanen (2002). Schaltegger (2002) positions ecopreneurship with the matrix shown in Figure 1, to measure how well a company has done for being a green business. The combination of these dimensions allows us to distinguish ecopreneurship into 6 positions (Figure 1). According to Schaltegger (2002), the companies’ positions can shift from one to another in different phases of business development since the framework allows the companies to assess and position themselves to which position, they are in the past, at the present, and in the future.

![Figure 1 Business continuum: the relationship between the priority given to environmental issues as business goals and the market effect of the business](source: Schaltegger and Petersen, 2001:10) (retrieved from Schaltegger, 2002)

Jolink and Niesten (2013) stated that the business model can identify the balance between 'planet and profit' from the nature of sustainable entrepreneurs. The business model has been increasingly studied in the research regarding sustainability in recent years, the so-called ‘Sustainable Business Models (SBM)’. The SBM was built with an integration of a triple-bottom-line approach (i.e., economics, social, and environmental) and the interests of stakeholders including environmental and social interests (Bocken et al., 2014). I agree that SBM could help embed sustainability in business purposes and serve as a key driver of competitive advantage (Bocken et al., 2014) because SBM could present the entrepreneurial approach of the company that wants to drive society into sustainability. I see the business model as the thought and activities of entrepreneurs. Therefore, it can see the entrepreneurs' activities through their business models.

Before going deeply into the SBM, we first better understand what the business model is in general. The business model (figure 2) is a series of elements including the value proposition, the value creation and delivery, and the value capture. First, the value proposition is how the company wants the products and services to be seen e.g., customer segments, and customer relationships. Second, value creation and delivery is representing how the company creates value for society e.g., key activities, resources, channels, partners, and technology. And lastly,
the value capture is the benefits that the company created from their value creation element, for instance, cost structure and revenue. (Bocken et al., 2014)

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Value creation &amp; delivery</th>
<th>Value capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product/service, customer segments and relationships</td>
<td>Key activities, resources, channels, partners, technology</td>
<td>Cost structure &amp; revenue streams</td>
</tr>
</tbody>
</table>

*Figure 2 Business model innovation (Bocken et al. 2014 adapted from Richardson, 2008, Osterwalder and Pigneur, 2005)*

The type of business model from Bocken et al. (2014) is divided into 8 types, the so-called ‘archetype’ (figure 3). Bocken et al. (2014) introduced the archetypes of SBM to develop a common language that can help speed up the development of SBM in research. The archetypes were categorized first by the higher hierarchies of business model types which are technological, social, and organizational, and second by the specific company innovation initiatives that are related to the higher hierarchies (Bocken et al., 2014). However, I argue that the categorization of archetypes is still vague since it does not mention if the initial goal of the company is from more than one archetype, and whether the archetypes are mixable. Moreover, the aspect chosen to categorize the archetype is based on ‘how’ the company projects its goal but does not focus on ‘why’ they choose to drive the company with that. Therefore, I suggest that applying the archetype of Bocken et al. (2014) will benefit to see the whole strategies of the company. In addition, I also suggest keeping in mind the aspect of ‘why’, to what reason led the company to do that.

Under the concept of sustainable entrepreneurship that I applied in this thesis to seek the activities that entrepreneurs have and use to lead the companies, I then build the conceptual framework related to the activities of the entrepreneurs i.e., the business model of the company. These two concepts will lead to more understanding in the context of entrepreneurship involved in the sustainability transition. Moreover, this conceptual framework might show the genuinely sustainable entrepreneur and/or greenwashing.
2.2.3 Sustainable Entrepreneurship in the innovation system

In this study, I am seeking to understand the actors’ entrepreneurial activities. There is some literature focusing on the niche level in sustainability transition studies, such as the Multi-Level Perspective (MLP). Hörisch (2015), for instance, highlights that sustainable start-up activities can support the sustainability transition by increasing the market share or substituting existing products with sustainable products and services. Hörisch (2015) argues that start-ups might act at both niche and regime levels (e.g., supplying larger companies with inputs), rather than only at the niche level. Although Hörisch found that the interaction between the actors at the niche and regime level helps accelerate the sustainability transitions, it has yet to be empirically integrated before in the MLP framework.

Given that the actors I study are on the niche level, rather than MLP I choose the Technological Innovation Systems framework, studying the innovation system that is centered around insects-as-food and feed.

However, Alkemade et al. (2011) found two shortcomings in the TIS literature. First, the framework is good at finding the system’s weaknesses, but it does not have a clear explanation of how actor strategies can create system weaknesses. Second, it has no clear overview of the strategies that entrepreneurs have, and how they contribute to the functions in different development phases. From these shortcomings, Alkemade et al. constructed a classification of actor strategies building on the framework of Aldrich and Ruef (2006), to see the role of actor strategies and their influences on the system weakness: at the organization level, within-population, between-population, and community level. In addition, Alkemade et al. also
distinguished between competitive and cooperative strategies. I argue that although the system of niche and novel industries might adopt cooperative strategies in the beginning, it is difficult to distinguish the competitive and cooperative strategies in other phases of system development because strategies and system dynamics might change over time. I agree that it is important to keep in mind both strategies, and I framed the questions to see how the business activities or business models of entrepreneurs change over time.

Likewise, Gibbs (2006) agrees that engagement with sustainable entrepreneurship will help sustainability transition studies progress. The created value is that transition management focuses not only on individual actions but also on the networks and support structures (Gibbs, 2006). The focus of the transition management framework is the changes, particularly, in the socio-technological regime and/or landscape e.g., political and social context, while the interesting area of this study is at the niche level. Moreover, in the novel and niche market which has several uncertainties, plenty of firms are in and out of the market often. Within the firm's business models, actors such as the founder, the CEO, and the manager influence the company’s decisions.

2.2.4 The application of frameworks

Following on from the previous sections on theoretical frameworks, this study emphasizes the importance of focusing on firm-level dynamics in sustainability transition research. In line with the existing literature, it posits that firms play a key role in sustainability transitions. This study uses business model innovation as a lens through which to examine sustainable entrepreneurial activities, dividing them into three key areas: value proposition, value creation and delivery, and value capture.

To gain a comprehensive understanding, business models are constructed based on the narratives and experiences of different entrepreneurs. The aim is to uncover the underlying motives and considerations that drive their decision-making processes. These could include seizing opportunities or overcoming barriers, and the study will further explore how these business models evolve. This is particularly relevant as different firms may have different objectives or may not have been established at the same time.

In addition, the study seeks to integrate insights from the Technological Innovation Systems Framework. Specifically, the framework is used to clarify how activities at the actor or firm level can influence or induce changes at the broader system level. Through this multifaceted approach, the study aims to provide a deeper understanding of the interplay between sustainable entrepreneurial activities and systemic transitions.
3 Methodology

3.1 Research Strategy
As the aim of the research is to understand their sustainable entrepreneurial approaches and activities changes during the different phases of business formation, the researcher has to interpret the applied theory and qualitative data from the finding. So, the research strategy is qualitative research, which applies an abductive approach. An abductive is a back-and-forth step of research, it starts with surprising information and tries to seek its explanation (Bell et al. 2019). Similarly, I start by gathering information from the interviews, then seek to identify the phenomenon. From the mentioned reason, this may be similar to the inductive approach. However, it might have insufficient empirical data, since the focus of the industry is in a niche and novel industry. Therefore, the back-and-forth step between theories and findings will be utilized to help build empirical results.

Understanding the actions and motives of entrepreneurs is important because I believe that different people have different approaches. In addition, some of the selected respondents have left the business, some are existing, and some are just starting. Hence, from these selected participants, the result of the research can show the similarities and differences, barriers, and opportunities faced by entrepreneurs in different periods. Moreover, the result also shows the activities (business model) of each company and implies how different actors dealt with the challenges in different ways. Therefore, the epistemology used in this study is interpretivism. I interpreted each interviewee's response to each company's story and tried to repeat or use the same words that the participants said to keep their meaning and emotion. However, the challenges of interpretivism can be outlined as follows. There were sometimes when participants were telling stories with emotions, and in order not to create any possible conflicts, I decided not to use such empirical material.

3.2 Research Design
As the research aims to understand the motivation and activities of individual entrepreneurs at different stages of business formation, the research design is referred to as a longitudinal case study research design of case study of Swedish edible insect companies and related persons. This longitudinal case started around the year 2010s when the first (group) edible insect company was established in Sweden. The case has therefore been developed over 10 years, a so-called retrospective interview. The retrospective interview is frequently seen in longitudinal studies or longitudinal case studies since the research is conducted for a long period or conducted interviews that talked about the stories that lasted for some period. One limitation of this research design is that some of the participants' memories or attitudes may be influenced by the current situation. Another limitation or drawback of the retrospective interview is that the correct period may not be identified. To mitigate the misidentification of time and the possibility that the story told by the participants is shaped by the present, I applied the news or blogs that were written at that time as a secondary source to help.
3.3 Data Collection and Sampling

The data is collected from both primary sources (interviews) and secondary sources (e.g., the book “Äta insekter” manifesto written by an industry representative, online websites, news, reports, etc.). The interviews are conducted in semi-structured interviews, and the interviewers asked some more follow-up questions, to have more understanding and insightful details. First, the primary source of data is the data I got from the interviews, which is mostly about their motivation and activities in the insect business path, their barriers and how they overcame those barriers, the reasons for continuing or stopping, and their perspective of the insect industry in Sweden in the future. It was more in a way that they tried to visualize the story and expressed their feelings or reflected on these barriers. Second, the secondary source was gathered from online-based resources as mentioned before, and a book called ‘Äta insekter’. The secondary sources helped me understand the timeline and the events that happened because they were written then. However, most of the secondary resources were written or recorded in Swedish, which is not my mother tongue. I used this translation application to help the understanding, but there might be some mistranslations, so this is a point to be concerned about when conducting the research.

As the study focuses on the niche market (Swedish edible insect industry), purposive sampling is utilized, to identify the right research participants. I started by searching the past news on the Internet. Then I listed the numbers of people with their contact details. I first tried to contact some of them by email, but it was not successful. Then I changed to contact via LinkedIn message and asked for their interest in doing an interview, asked for their email or mobile phone and sent the invitation letter, interview questions, brief information about the thesis, and letter of consent to participate in the interview. After conducting the interviews, I then asked for more companies or people they knew in the industry, a so-called snowball sampling method. Therefore, the sampling method was a combination of purposive sampling and snowball sampling methods.

The interview sample consists of 14 interviews from 15 participants since one of the interviews was conducted with 2 participants. All of the interviews were conducted on Zoom video calls, which last approximately 35 minutes to an hour per person and are arranged between February to April. To allow the interviewees to speak openly, I guaranteed their confidentiality. Before the interview, I provided a consent form and asked for permission to record the interview. In addition, I will send the draft and final versions of the research to the interviewees before it is published.

3.4 Data Analysis

After conducting the interviews, I found that two interviews were not related to the topic of sustainable entrepreneurship, so I decided to remove two interviews from the empirical findings and analysis section. The reason is that those two interviews are not specialized in the business sector of the Swedish insect industry. Most of the qualitative research applied the thematic or ground theory analysis method, but I agree that understanding the full motivation and activities of entrepreneurs in a longitudinal case study is better analyzed in a narrative way.
The narrative analysis enables exploration of the organization or individual (firm-level) as a variety of perspectives coexist (Bell et al., 2019). Moreover, it is a suggested analysis that suits to study of firm-level culture and change (Bell et al., 2019). I applied a narrative analysis, which shows in a storytelling style of writing so that the reader will understand all the phenomena that happened in the past years of the industry. It is an analysis of the spoken language that describes the events and emotions of the participants.

The narrative in the following chapter (chapter 5) is structured in a simple story structure: beginning, middle, and end. The beginning of the narrative starts with the motivation and the establishment of the company. Since when I let the company tell their stories, they usually started with opening phrases such as "It starts in ...(year)...", "I came to this industry in ...(year)...", or "All right! I will start with my name...". So, I know from these opening sentences that the journey of the company starts at this point and that the motivation of the entrepreneurs is told after these sentences. Then in the middle of the narrative, the company started talking about the situations or barriers that occurred and how they tried to overcome them. Some of the interviewees were asked to tell those activities by the prepared semi-structured interview questions, while some told the story continuously from the beginning. Moreover, I also asked for some additional detail regarding the operation and distribution if the interviewees missed mentioning, to get an overview of the business models. Lastly, the end of the narratives is mostly about the current status of the company, whether they are closed or still operating, and what the reasons are if they closed. In addition to that, I also asked if they have any guidance for new entrant companies, or how they see the Swedish edible insect industry in the future. The analysis is written company by company and wrapped up the synthesis at the end of the section. However, to create the narratives, coding is an essential step to be applied.

3.5 Coding the narrative data

After receiving a set of data, I began to construct the code to examine what businesspeople were doing, with a focus on sustainable business models, as well as the barriers and opportunities they faced (see Appendix 2). I started by breaking down the transcripts and converting them into narratives. I then sought the similarities and differences between each company's narrative and ultimately constructed the core narrative (see Chapter 5.2.1). As such, this approach can be classified as an inductive method. Through this process, my research not only scrutinizes the data closely but also builds upon the findings of other studies. This results in a comprehensive and well-informed examination of how businesspeople work towards sustainable practices in the face of various barriers and opportunities.

On the other hand, the coding of the TIS is conducted using the deductive method, in which a set of codes is created before the synthesis. The mentioned coding is the 7 key functions of the TIS. After analyzing the transcripts and converting them into narrative form in Chapter 5.1 using an inductive method, I identified activities that could be related to the key functions within the TIS. Then the data was broken down into Chapter 5.2.2.
3.6 Interview lists

The list of interviews below (Table 2) shows the number of companies participating in the interview, the status of the company, the role of the participants, the contact channel, and the duration of the interview. The interviews were conducted using the Zoom application and lasted between 33 and 78 minutes. The difference in duration depended on the availability of the participants and the length of the answers given by the participants. The latter is mainly due to the fact that some enterprises have not been in operation for a long time or have only been in operation for a short period of time. There is also a note on interview 11* as it was conducted with 2 participants at the same time. However, the number of questions asked is only the same and similar in all companies, but different in interviews 12 to 14, which are conducted by a journalist and two researchers. The questions asked are shown in the interview guide in Appendix.

Table 1 The interview lists in the thesis

<table>
<thead>
<tr>
<th>Interview no.</th>
<th>Participants information</th>
<th>duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Company A quit co-founder</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Company B running co-founder</td>
<td>78</td>
</tr>
<tr>
<td>3</td>
<td>Company C running CEO and co-founder</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Company D quit Founder and former CEO</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>Company D running CEO</td>
<td>53</td>
</tr>
<tr>
<td>6</td>
<td>Company E quit founder</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>Company F running co-founder</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>Company G quit founder</td>
<td>45</td>
</tr>
<tr>
<td>9</td>
<td>Company H quit co-founder</td>
<td>33</td>
</tr>
<tr>
<td>10</td>
<td>Company I running co-founder</td>
<td>58</td>
</tr>
<tr>
<td>11*</td>
<td>Company J R&amp;D department Project manager</td>
<td>51</td>
</tr>
<tr>
<td>12</td>
<td>Journalist/website owner/ book author</td>
<td>66</td>
</tr>
<tr>
<td>13</td>
<td>researcher</td>
<td>55</td>
</tr>
<tr>
<td>14</td>
<td>researcher</td>
<td>34</td>
</tr>
</tbody>
</table>

*Interview 11 consists of 2 participants, a project manager, and a project assistant

3.7 Quality of research

3.7.1 Credibility

Credibility refers to evidence supporting the social reality to ensure that the research is carried out with good practice and submitted to other members of the studies for the confirmation of the interpretation, which is often called respondent validation or member validation. Since this study is conducted by one researcher, the analysis of the study will be based on one perspective. The respondent validation, therefore, is not able to be measured in this study. However, another
often applied technique is triangulation which refers to the study that uses more than one method or source of data in the study of social phenomena (Lincoln and Guba 1985 cited by Bell et al. 2019). It can be ensured that this study has good credibility since this study is applying mixed sources from both primary and secondary as the supported evidence.

3.7.2 Transferability

Transferability refers to “whether or not the finding holds on some other context, or even in the same context at some other time, is an empirical issue”. (Lincoln and Guba 1985 p 316, cited by Bell et al., 2019) It means that the result and finding must be the same even if the situation or time has changed. To increase the transferability of this study, the evidence which is the interviews, are conducted individually and the researcher has promised the interviewees by keeping all the interviews anonymous and will use them for research purposes only, for the interviewees to disclose their approach and willing to share their deep information.

3.7.3 Dependability

Dependency “involves the adoption of auditing approach which ensures that complete records are kept of all phases of the research process” (Lincoln and Guba 1985, cited by Bell et al., 2019 p365). To increase the dependability, this research records all interviews with the video recording tool in the Zoom application. Then all the videos are transcript by transcription tool in Microsoft Word program. Lastly, to prevent mis-transcript or wrong-used words, the research runs through the audio clips again and changes the incorrect words. In addition, in the analysis section, I tried as much as possible to use exactly the same words that the participants used to preserve the core meaning of the message they expressed.

3.7.4 Confirmability

Confirmability is to ensure that all the findings are not happened to be by bias either from the participants or the researcher. To increase the confirmability of the research, this study provides a list of questions to the interviewees beforehand, to prevent bias from the interviewer.

3.8 Ethical aspects

The research was conducted with interviewees involved in the food and feed insect industry, which is still a niche market. This means that there are not many players in the industry these days, so to avoid any possible conflict or misunderstanding in the ecosystem, I decided to keep the names of all interviewees anonymous.

No deception: I informed participants of the interview questions. And when asked, I also told them the name of the company or person I was interviewing. This allowed participants to know which company I had interviewed or was planning to interview. I protected the confidentiality of the participants and the companies, and if I thought there might be a conflict, I did not tell.
4 Results

4.1 Empirical Findings and Analysis

4.1.1 Insect-based food industry’s position in Swedish Market

To assess the insect-based food market position in Sweden, this paper scrutinizes the recent scientific literature, and EU and Sweden regulations. The International Platform of Insects for Food and Feed (IPIFF) has recently declared 600 million euros was invested in 2019 by European insect producers and is expected to reach 2.5 billion euros by the mid-2020s (IPIFF, 2020). According to IPIFF, differences in European state members’ approaches lead to several insect-based products for which the insect species are not yet authorized by the EU. The products which were in the market before the 1st of January 2018 are allowed to continue until the final decision on the application of the novel food is taken, to let the entrepreneurs adapt to the new regulatory landscape. (IPIFF, 2022)

After the announcement of EU regulation 258/97 (table 2), the whole body of some species can recently be sold in the Swedish market as food. Many insect-based food and feed companies have been working in the Swedish market, namely, Tebrito, Eatem, Nordhub, and Petgood. Tebrito believes that insects are one of the innovative protein sources that bring about sustainable solutions to the food challenge (Tebrito, n.d.). Other stakeholders that exist in this industry show biotechnology companies, namely, Norbite, and companies who breed house cricket as suppliers for insect food and feed companies. However, since the insect-based food and feed industry is still in the early stage, especially the insect as food, plenty of companies had stopped producing because of several reasons. One of those reasons is Swedish regulation. For example, Hakuna Mat was one of the insect-based food companies in Sweden, that stopped selling its products due to the unclear released regulation in Sweden (Breakit, 2018).

Later, it was clear that Swedish Food Agency was holding their old interpretation that whole insects are required to be approved and decided to take all products from the market since they were concerned about people's health. The consequences of holding different interpretations from other EU countries brought companies to stop their operation.
Table 2 The chronologically ordered set of the released legal documents regarding insect production for food in the European Union and Sweden

<table>
<thead>
<tr>
<th>Years</th>
<th>Event</th>
<th>Reference</th>
</tr>
</thead>
</table>
| 1997     | 1. EU regulation 258/97 defines ‘food’ as novel foods if it has not been used for human consumption to a significant degree within the EU before 1997 and fell within certain specific categories including ‘food ingredients isolated from animals’, resulting in edible insects as novel foods.  
2. EU regulation 258/97 was repealed and replaced on January 1 with the entering into force of EU regulation 2015/2283. The new regulation expanded the categories of novel foods. This movement allows whole insects, part of whole insects, and insect-based preparation to be placed on the EU market.  
3. House cricket (Acheta domesticus), Mealworm (Tenebrio monitor), Honey bee larvae (Apis mellifera), European Locust (Locusta migratoria), Tropical house cricket (Gryllodes sigillatus), Buffalo worm (Aliphitobius diaperinus), and Black Soldier Fly (BSF) (Hermetic illucens) have been submitted in 2018, so they are applied the transitional rules to be able to be in the market until the final decision.  
4. The European Court of Justice concludes that food ingredients isolated from animals cannot be interpreted to include whole animals, including whole insects, and that whole insects were not covered by the old legislation, EU regulation 258/97.  
5. The fact that whole insects have exempted from EU regulation 258/97 means they are permitted for sale in all EU countries during a transition period, as long as an application for authorization has been filed with the EU Commission no later than January 2, 2020  
5.1 On October 27th, the Swedish Food Agency announced that Sweden will take part in the transitional rules while waiting for the final decision from EFSA, so the mentioned species of insects in row number (3) are allowed to be in Swedish market.  
6. Authorizing the placing on the market of dried Tenebrio monitor larva (as whole and powder) as a novel food under Regulation (EU) 2015/2283 of the European Parliament and of the Council |
8. Authorizing the placing on the market of frozen, dried, and powder forms of yellow mealworm (Tenebrio monitor larva) as a novel food under Regulation (EU) 2015/2283 of the European Parliament and of the Council  
| 2020     |                                                                                                                                                                                                 | Livesmedelsverket, 2020     |
| 2022, Feb|                                                                                                                                                                                                 | Commission Implementing Regulation (EU) 2022/169, 2022  |
|          |                                                                                                                                                                                                 | Commission Implementing Regulation (EU) 2022/188, 2022  |
4.1.2 The path of Swedish insect companies

This section presents a chronological description of the activities in a narrative story that have taken place in each company in the Swedish edible insect industry. To gain a better understanding of the companies' stories, I have categorized them into a group that is divided according to the characteristics of the companies in the market, such as role, product areas, and relationship in the ecosystem as the following diagram (figure 4).

Figure 4 Insect-based companies’ roles and relationships in Sweden (own figure)

The diagram shows the positions of the companies, divided into product areas based on insect species: mealworms, crickets, black soldier flies, and mixed insects. The same diagram also shows the relationship between companies as suppliers or customers. Some companies breed the insects themselves, namely Company B and Company C. Some of the companies are still in operation, but some have already stopped, some have already launched products, and some are still in the research stage, all of these criteria will be told in the story of each company. However, the company that is colored green [Company I], is an insect breeding company, which is different from other insect companies that aim to produce insect products, while this company aims to provide a sustainable way of breeding and rearing insects. Moreover, the last story in this report is about a tech journalist who has a wide knowledge and good relationship with Swedish insect companies, so with his story, I will understand a bigger figure of this ecosystem.
In 2016, the idea of using insects to reduce food waste and to be fish feed was risen by the two founders of the company. After a small talk, they decided to start a business.

“It was mainly…. let's call it mission-driven in innovation. There is the problem with overfishing in the world seas, and we have also a problem with food waste.” [interview no.1]

At the mingle, there were lots of people joining and several business ideas had been mentioned, and one of the ideas is using mealworms. Although the mealworm has several benefits, the idea had to be changed because the mealworm needs around ten weeks to be ready to harvest. Then, they decided to change to Black Soldier Fly (BSF) which is much faster growing than the mealworm.

“...let's see if we can find another insect that has a faster life cycle, and the black soldier fly is much faster. It does require a bit of special treatment for it at work.” [interview no.1]

After settling on the idea of growing BSF, they divided the responsibility among them and gathered all their knowledge on their own of growing BSF from webpages, blogs, videos, etc. since neither of them knew how to do this. They were working on the theoretical side for around a year. And since the interviewee has a background in economics and biotechnology, the interviewee worked more on technology, however, it was just a two-man company, the responsibilities were not clear cut.

“There, there's quite a lot of knowledge on this [on growing BSF]. Seems like the research wants to spread this. So, it's just not on research papers, but it also blogs, webpages, providing information, linking to these papers...” [interview no.1]

“...on YouTube videos on how to use [BSF], in English...on how to build a small insect production facility to reduce food, scrap waste, ...” [interview no.1]

To start breeding, it is important to have eggs. They got the initial eggs from one university which was doing research on waste management with insects, so they bought BSF from them. While growing the BSF, they were also looking for customers, and once they met with a fish farmer. The farmer was interested in feeding their fish with insects, so the deal looked perfect. The fish farmer was also passionate about being environmentally friendly as well. Moreover, the fish farmer suggested they talk to the biogas company to complete the circular economy in this food system.

“he [fish farmer] said initially, yeah... I want to feed my fish with insects...this is perfect...I'm doing this for the environment as well.” [interview no.1]

The operation and production seemed to be going well until they realized that they could not feed their insects with food that was considered waste under the regulations. Although they thought that insects could eat anything, insect production used the same classification as pig
production. Therefore, insects could not be fed with the same waste as pigs. Company A's idea was to take these by-products or side stream before they become waste and then use them as insect feed. All the companies saw this as a win-win situation and a good ecosystem. And since the insect production was not too big at that time, there was enough supply of feed.

Later, when they were about to be ready to supply insects to the fish farmer, the fish farmer said that they were not sure if they still wanted them. Company A then found a new small fish farm that wanted to try out, they tried and found that the fish grow well with the insects. After testing, they looked for feed producers to produce their insects into fish feed. The first one requested a large quantity of insects, but it was too much. Then they found the second smaller one that asked for only one ton to do the test batch. However, the feed producer needed some money to start the production, so the company decided to wait and thought about other choices to overcome this barrier, whether trying to sell it before producing or shifting the target to the pet food industry.

“...If we were to sell to the fish feed industry, I think we would have 15 krona per kilo and we would have 35 to the pet food industry. So that would be excellent for our budget calculations as well. If we could sell to the pet food industry, it would change our mission producing the overfishing, but it would get us running so we can then target the bigger market afterward.” [interview no.1]

They were trying and thinking so hard to overcome the situation which was mainly about finances. Eventually, the company decided to stop after 2 years of operation. Before closing the company, they got a prize from an entrepreneurship contest, and another from the Energimyndigheten [Energy agency] but that was not enough to cover all expenses. They, eventually, had to close down the business anyway. They were also thinking about finding investors, but it might be another additional year to start up again. They mentioned that they would try to sell as much as possible from day one if they could go back in time, or do something else that they had experience with, such as found a biotechnology company.

“One of your questions was, what would you have done? Um, going back in time. Sell? Yes! try to sell from day one...and coming up with arguments, trying to listen...really sell, sell, sell.” [interview no.1]

They mentioned that they had talked to some of insect entrepreneurs once in a while but most of them were in the business of insects for human consumption. And Company A was not a member of a lobby organization to be able to sell insects. Anyway, if we look at the surrounding at that moment other suppliers or people who were involved in this area were also struggling.

“...because they were also a startup, so everyone in the business startups, and they, it's like, no, not yet. Not yet. So, timelines were just kept on going forward.” [interview no.1]
Sustainable Business Model of Company A

Value Proposition: Company A's value proposition was to address two major global issues: overfishing and food waste. They wanted to do this by using insects, specifically Black Soldier Fly (BSF), to reduce food waste and serve as a sustainable source of fish feed. This innovative approach was designed to create a circular economy in the food system and contribute to environmental sustainability. The company's value proposition also appealed to environmentally conscious stakeholders interested in sustainable practices.

Value Creation & Delivery: Company A created value in several ways: First, they introduced a novel solution to the problem of overfishing and food waste by using BSF as a sustainable source of fish feed. This innovation was based on extensive research and knowledge gathering. Second, they established partnerships with a university for the first BSF eggs, a local company for fruit and vegetable waste, a fish farmer, and a biogas company. These partnerships allowed them to create a circular economy in the food system and further increase their value creation. And lastly, they effectively used resources that would otherwise be wasted. They used food waste as feed for the BSF, which in turn was used as fish feed. This approach not only reduced waste but also created a new, sustainable product.

Value Capture: Company A's value capture strategy seemed less defined and successful compared to its value creation and proposition. Their initial aim was to sell their BSF to fish farmers as a sustainable source of fish feed. However, they faced challenges such as regulatory restrictions, uncertainty from their main customer (the fish farmer), and high production requirements from feed manufacturers. They also had an income from joining the entrepreneurship contest and energy agency. However, this income was not enough to cover their costs and they eventually had to close the business due to financial difficulties. They considered shifting their target market to the pet food industry, which offered a higher price per kilo, but they did not pursue that eventually, as the demand for the test batch from the pet food producer was higher than their production capability at that time.

Company B, interview no.2 (2017-present)

Company B was founded by Swedish founders and has its production based in Thailand. The inspiration came from watching a TV program about insects in 2011 and from knowing a friend from innovation school, who lived in Thailand. With some awareness that insect farming and consumption were prevalent in Thailand, they decided to explore opportunities there. Initially, they focused on the sago beetle, as it was commonly eaten, but this beetle typically inhabits only specific sago trees. Due to this limitation, they shifted their focus to crickets and set up their first cricket farm in Chumphon, Thailand. The interviewee happened to reconnect with an old friend through Facebook, and since they were both living in Thailand at the time, they arranged a meeting and decided to start the company together. They had to relocate their production base several times for various reasons, such as flooding during the rainy season, and also because they transitioned from focusing on beetles to crickets. Ultimately, they began building the farm that they operate today in Hua Hín, which was established in 2016 with the
goal of providing sustainable alternative food sources. They initially funded the venture with their own money and later invited friends and relatives to become company shareholders.

“...when I started this [the company], it was not so much the business in the first place. It was more like saving Mother Earth.” [interview no.2]

In the beginning, the company purchased feed from other suppliers, but later it opted for more controllable and traceable production lines. This control could potentially enhance their competencies in comparison to other companies. They realized that it would be advantageous to have a feed company as well, to develop the optimal feed for their insects and the world. Additionally, if large quantities of feed are needed, this approach is sensible. Furthermore, they ensure that crickets from their farm consistently maintain high quality and taste. Currently, they are using a portion of feed made from soy, which does not significantly benefit the growth of the insects due to a lack of protein. As a result, they have reverted to using soy flour.

“...so we have 100% control of what they eat and drink and be violent. Where we had them. So, it's important...it's not many companies can show up that quality on the crickets that we have, and a lot of companies have tried others [the taste of cricket], and so this one taste best.” [interview no.2]

In terms of feed, the interviewee is considering more sustainable business models, such as food parks. They suggest that insects could be fed with dead fish. However, regulations currently prevent this. They argue that those who draft regulations should prioritize more pressing concerns, such as environmental sustainability, instead of restricting the types of feed that can be used for animals. Furthermore, they highlighted the issue of catching small Baltic herrings to feed salmon, which they believe needs to be addressed. They suggest that salmon could potentially be fed with insects.

“...if you give insects to the salmon in Norway for example, it's of course they're eating it. Otherwise, you shouldn't have any fly fishing because it's so normal, so they should concentrate on the more important part. How to change, as I said, to build a new feed without destroying Mother Earth. And as I say, seaweed is perfect [to be part of insect and other animal feed]. It's like we should really do a hard job...” [interview no.2]

“...for two years ago big fishing trollers they were emptying the sea from Strömming, the small herring ... that made the fish meal up to Norwegian salmon farms. Is crazy, so they're killing the sea and. And that's why we must get away from it... we must change the whole cycle we are using today. It's crazy. It's a suicide we're living in.” [interview no.2]

Additionally, the interviewee outlined their vision for building a circular economy. They have been in contact with some fish farmers to ascertain if there is a shared interest in this vision. The plan involves using the fertilizer or manure from fish and insects to cultivate tomatoes. The remnants or waste from the tomatoes would then be used to feed insects, which would in
The cycle eliminates the need for transporting materials globally. The interviewee stated that on their farm they are striving to be as environmentally friendly as possible and are concerned about waste from production, such as egg cartons, cleaning bottles, shoe covers, etc., which are hard to avoid.

Initially, the interviewees didn't face many challenges. However, as regulations evolved, they encountered more obstacles. Dealing with multiple currencies also presented issues, as they lost nearly 3 million Swedish kronor due to currency fluctuations. Despite these challenges, the company garnered interest from Japanese firms and is expecting further investment. The company has managed to sell its products in Finland, England, Germany, Japan, Indonesia, and Thailand, as these countries adhere to older regulations that differ from those in Sweden. The products are also being sold in gyms in Thailand, where sportspersons are considered early adopters. According to their website, the company has partners based in both Thailand and Sweden. They operate in both B2B and B2C markets, selling cricket powder to allies for the production of various products including beverages, food, and pet food, while also manufacturing their own products such as protein bars. The interviewee mentioned that media is one of the barriers that build on the yucky feeling of eating insects. To counter this, the company aims to emphasize the high nutritional value of insects and is creating products like cricket powder and protein bars instead of using whole insects.

“...media is one of the biggest problems we had so far because they're always selling on the yucky factor. So it's always a person with an insect on the way into the mouth, you know... but I think if we start with the sport... it will open up [the acceptance].” [interview no.2]

“...I hope that the media. And I have seen them start to write more interesting about insects. It's not like you know it more wow how come this? Change for Mother Earth...wow! we can save water. So, you see a more interesting part.” [interview no.2]

With the sale in progress, they are actively working on it. They have hired an outsourced marketing company to manage the sales, and it might become possible to order from anywhere in the world in the near future. In Sweden, they have partnered with another company to establish a circular economy farm, but this project is still in its early stages. They are hopeful that it will materialize.

“...it should be very nice if we could start that [the farm project] now it could be changed. That was the beginning of it, to change the way how we get our food to our tables in a way that could be for the future because we must change, and we must accept it.” [interview no.2]

A notable difference between production in Sweden and Thailand is the labor cost. The interviewee cited some examples of problems that arose during the initial phase of the company's operations in Thailand. For instance, the laborers overfed the crickets, resulting in a consumption of over 5 kilograms of feed per kilogram of cricket. The language barrier also posed a challenge. As of now, they have opted to downsize their operations as they seek
additional investors. With these investors, they aim to construct a next-generation farm that will create job opportunities for the local population. In addition to their operations in Thailand, they are considering scaling up, possibly in Sweden, as a means to command higher prices; however, they maintain that this decision will be contingent upon market growth. They believe that with their wealth of skills and experience, it would be prudent to establish new production units anywhere in the world.

“...when you lack money, you must find cheap laborers. You get what you pay for. So, we had problems with that.” [interview no.2]

“...then the next step will be to build the next generation of the farm. We will not have 100% automatic optimization because we hope that we could give women in Thailand the possibility to have a job that can raise the kids, because there are some problems you know, so it could be a good thing. For a win-win...” [interview no.2]

Currently, with the accumulated experience, they understand the importance of not investing all of their personal funds into the company. Instead, they should actively seek as many investors as possible. They are also considering building a small farm in Sweden, where communication and research can be conducted more efficiently. Lastly, they mentioned that it might be wise to launch the business when the market is receptive, as this would reduce the barriers faced by new entrants.

“...It should be perfect to start now when the market is ready. I'm always too early because I'm an innovator.” [interview no.2]

**Sustainable Business Model of Company B**

Value Proposition: Company B addressed the production of sustainable alternative food sources, specifically crickets, to address environmental concerns and contribute to the circular economy. Their mission is to reduce the environmental impact of traditional food production methods and provide a high-quality, sustainable protein source. They aim to achieve this by controlling and tracing their production lines, ensuring the same quality and taste of their crickets, and developing their own feed for the insects.

Value Creation & Delivery: Company B created value in several ways, whether innovation, controlled and traceable production, or sustainability. First, the innovation creation, they have innovated in the field of sustainable food production by farming crickets, a protein source that requires fewer resources than traditional livestock. Second, they maintain full control over their production process, from what the crickets eat and drink to their living conditions. This allows them to ensure the quality and taste of their product will always be the same, which they believe sets them apart from other companies. And lastly, they are committed to sustainability and want to contribute to the circular economy. For example, they have considered building the project together with a food park in Sweden, using waste from food parks to feed the crickets,
then using those crickets to feed fish, and have explored the possibility of using waste from their cricket farms to grow tomatoes.

Value Capture: Company B captures value through the sale of its cricket-based products. They market their products both directly to consumers (B2C) and to other businesses (B2B), which use their cricket powder to produce various products, including beverages, food, and pet food. They have managed to sell their products in several countries, especially in Thailand, and are working on expanding their market reach. They have also received interest from a Japanese company. These investments have provided them with the necessary capital to continue their operations and expand their business.

Company C, interview no. 3 (2016-present)

Company C was founded by Swedish entrepreneurs, and I had the fortunate opportunity to interview a co-founder and CEO of the company. They shared that the inception of the company was sparked by an article they read about insects and how insects can be utilized to derive value from biomass. The insect they chose to focus on is the ‘mealworm,’ mainly due to its energy efficiency and low carbon footprint.

“Mealworms are very, very energy efficient. We have measured our carbon footprint print as long as we use residual streams, we only meet 1.5 kilos of carbon dioxide per kilo of dried mealworm. That's amazingly low...compared with other animals and the protein quality is the same as beef, uh regarding amino acid.” [interview no.3]

In 2012, they began to conduct extensive research on extracting compounds from insects and also started contemplating strategies to garner customer acceptance. At the time the interviewee was initiating the company, the interviewee was working as a professional IT consultant. With no prior experience or knowledge in this field, they had to learn everything from scratch, which was something they relished.

“...I've learned everything I can by myself; and I always try to take a little bit harder job challenging and I love to learn. But I haven't done a proper education.” [interview no.3]

Despite the interviewee’s extensive study on the extraction of nutrients from insects, a background as an IT consultant did not equip the interviewee with the necessary expertise. The first co-founder reached out to a friend who is a food agronomist specializing in the field, and this individual then became another co-founder of the company. Together, they established the company in 2016. A few years down the line, they made the decision to leave their previous jobs and operate the insect company on a full scale, beginning in 2019. Initially, they rented a facility to breed insects purchased from other producers. After acquiring more experience in insect rearing, they shifted to a new location and sold the initial site to another company interested in insects.
“...so today we are having 2000 square meters of food approved and pet food approved and also frass treatment facilities and primary production, climate sales office spaces, they have an automation room. So, we are expanding quite rapidly in big, old industrial buildings.” [interview no.3]

In the first three years of running the company, they were surviving on grants and free labor, which mean themselves. They also faced challenges, particularly regarding regulations that were not supportive. During the transitional phase of regulations [before January 1st, 2018], the Swedish Food Agency held interpretations that differed from those of other EU countries. This affected the legality of selling edible insects in Sweden. Company C, along with other companies operating during this period, faced this hurdle. Eventually, in October 2020, the Swedish Food Agency permitted the official sale of edible insects in Sweden. This is one reason why Sweden has fewer insect companies compared to other European countries.

“...Some other European company was before us, like the Netherlands. And so, in the Netherlands, settling insects for 10s of years. So, it was a very, very unequal Internal European market and that hasn't been good.” [interview no.3]

However, there was also a silver lining. They received grants from a climate-smart protein competition sponsored by a research institution, Vinnova, amounting to around half a million Swedish krona in 2016. During this initial investment round, they also invested a great deal of their time, which meant they forewent salaries. They were advised by an acquaintance from the science park to apply for this competition. They acknowledged that being heavily grant-funded was a double-edged sword, as they now hold only a minority of the shares, despite being the risk-takers in a market characterized by high barriers.

“...it's very hard to start a new company in a field where aren't allowed to sell your products.” [interview no.3]

“...that [the competition] was successful. So, we received the first investment into the company in 2019 and we have concluded three previous rounds and regarding investor equity, we have received around 42 million SEK today.” [interview no.3]

“...there is always a dark side of being an entrepreneur and the entrepreneur like to be they work harder if they are poor and they have taken all the risks, and then in the end you put yourself in a spot when you're someone else's gain from your successes.” [interview no.3]

The rapid growth of the company can be attributed firstly to its competencies and secondly to the synergy between them and other stakeholders. They employed a strategy of relentless learning and self-improvement, keeping pace with the growth of the company. The volatile nature of the market necessitates adaptability, which they embraced. They credit the company's promising trajectory to these competencies. They also highlighted the invaluable contribution of their dedicated staff, who share common interests and motivation. The second factor is the industry context. Collaboration is more likely when there is transparency between companies,
and when they share common objectives, such as environmental sustainability. Likewise, it is imperative for the team members to have aligned motivations and beliefs to steer the company in a unified direction.

“...the criteria when you hire recruit people is depending on the job...we have a very diverse, but they must be open-minded, be honest and has that little extra believe in what we do and be enough confidence that to work in a startup, very uncertain environment. It's not for everyone.” [interview no.3]

“... [the partner company] has mentioned as [Company C’s] solution as a way to fight global hunger and they're promoting in the search to debate. And so, that's why you have to be a trustworthy partner and also that be well respected...” [interview no.3]

“...we have a splendid board with a lot of great investors and industrial persons that have a long... they really believe in us.” [interview no.3]

The barriers or challenges in this industry were mentioned previously, such as the regulations from the Swedish Food Agency. While awaiting approval from the Swedish Food Agency, the company was working on frass derived from insect waste, as well as on insects for pet food.

Another activity that led to overcoming this barrier was ‘lobbying’. They said that being at the forefront, or being someone who initiates the industry, has to fight and lobby for one’s existence. Another challenge of being a pioneer is that many of the resources they needed were not readily available. Consequently, most of the materials had to be produced in-house, as there were no subcontractors or suppliers. The CEO mentioned that if they succeed, it will indicate that they are significantly ahead of their competitors. Conversely, there are encouraging indications emerging recently with market growth, such as customer acceptance. For instance, they conducted trials in schools where approximately 25 percent of students showed openness to insects.

“...25% [of the Swedish population] is 2.5 million. They have to eat some grams of mealworms and then we are satisfied...., it takes time also to build the market and products and then there are very good signs there. So, I'm very confident.” [interview no.3]

Additional positive signs include interest from new entrants, interest from traditional protein producers such as pig and fish farmers, and collaborations with other business partners. One pig farmer, for example, has excellent potential to transition to insect farming due to their wealth of experience and available farm. However, Company C does not focus on fish farming because the fish feed market is price-sensitive; instead, they are more interested in human and pet food. Furthermore, the company currently has numerous valuable connections and collaborations with major companies both in and out of Sweden, owing to their transparency and innovation.
“I had a visit from Pig Farmer just last week, I've heard three different pig farmers as one to go into the insect industry instead of raising pigs. And also, the fish fishing industry is very, very interesting.....I would say that they [pig farmers] had a lot of experience in equipment and practices that can be useful in the insect industry as well. So, it's a mutual collaboration, and the person I spoke to, he has, he has quit his pig farming. And he will [change to the insect]. But he has to wait for a year or two before us to be able to help him and have all the systems in place.” [interview no.3]

“...they [fish farming] are really demanding customers that pay a low price and needs at least 1000 tons would be relevant, so that market is like, yeah, all the bad things that you'd want for a scale-up [the industry]. So, we have diverted from the fish feed market going into pet food and food and we are actually selling all the larva as pet food and food today.” [interview no.3]

Today, the regulation has been lifted, leading to high prices for insects, especially since the company maintains good control over production and offers a traceable product. Their product line consists solely of mealworms in various forms, including whole mealworms that are marketed exclusively to businesses (B2B), and frass (manure) that is marketed to both businesses and consumers (B2B and B2C). Whole mealworms, sold as boiled, frozen, or dried, are their main product. The company is highly concerned about contamination and hygiene, so they endeavor to handle everything in-house from the breeding stage in order to control quality and safety.

“...We don't want to introduce path pains and always when you introduce. And then new insects within your stock, there is a risk of contamination and there is a disease. So, you have to be careful.” [interview no.3]

Currently, the company is heavily focusing on research and marketing. They aim to scale up rapidly but cautiously, having learned from past experiences and examples. Like many, Company C plans to commercialize its products further and aims to generate 30 million a year. They intend to sell feed, pet food, and human food to businesses (B2B), but they find that frass is more effectively marketed to both businesses and consumers (B2B and B2C) since the former market is quite conservative and they wish to establish a market presence. Based on their research, they plan to produce a fully developed frass product in the future. Looking ahead, the company aims to incorporate more automation in certain aspects of production to facilitate scaling up. One of the key messages the company wants to convey is its desire for more competitors to join and propel the insect industry forward, contributing to its success.

“...we actually want competitors. We also see bigger companies and we expect that this is pristine land from other Europeans, so we have to be forced and adapt and think industrial from the first, and in everything that we do in order to...[put this to be successful] even if we can make a good profit on segments right now, we have to be very efficient in order to really put this, this, this be successful in them and that's what we're aiming for.” [interview no.3]
Sustainable Business Model of Company C

Value Proposition: Company C’s value proposition is centered around providing a sustainable alternative to traditional protein sources through the farming of mealworms. The company emphasizes the energy efficiency and low carbon footprint of mealworm farming, which aligns with the growing consumer demand for environmentally friendly products. The company also highlights the high protein quality of mealworms, comparable to that of beef, making it a viable alternative for both human and pet food. Moreover, the company also provides frass from mealworms, which has already been experimented with and found that it helps increase the growth of the plant, as they tried with a grape yard in Spain.

Value Creation & Delivery: Company C creates value through its innovative approach to insect farming. The company has developed its own techniques and processes for farming mealworms, ensuring that they have full control over what the insects eat and drink, and how they are reared. The company also creates value through its commitment to sustainability. It uses residual streams to feed the mealworms, resulting in a low carbon footprint. The company is also exploring ways to create a circular economy in the food system, such as using waste from the mealworms to create plant nutrition, and potentially using waste from other industries to feed the mealworms.

Value Capture: Company C captures value through the sale of its mealworm products. The company operates in both B2B and B2C markets, selling their products directly to consumers as well as to other businesses for use in their products. As one of not many insect suppliers in Sweden, it makes the company has the power of being a supplier of mealworms in Sweden. That makes the company stay ahead of its competitors and quickly take advantage of new opportunities in the market.

Company D, interview no.4 (2014-present)
[Company D was founded by interviewee no.4 and sold to interviewee no.5 later, so the storyline will start with the storytelling of interview no.4 and continue with interview no.5’s story.]


The idea of founding the edible insect company was sparked when they read a United Nations report about crickets, which revealed that many people had tried various products made from insects, including shakes. Intrigued by the idea of making food from insects, they, along with three other friends, decided in 2014 to delve deeply into the industry. They began with the vision of creating a product that was both sustainable and healthy. They treated this as a project for the first six months and got an insect crispbread producer in Sweden. At that time, it was illegal to sell insects as food in Sweden, so they operated with the hope that it would become legal in the near future. Not long after, they won a food hackathon and received some funding in early 2016. They conducted market analysis surveys, asking if people were interested in buying sustainable and healthy food. However, they soon realized that this was not an effective way to frame the question.
“We framed it like would you like to eat something sustainable that's healthy? Like no one would ever [answer no], but everyone would answer yes, of course, and people. And of course, like asking people what they want to do. It's not a smart way to know to find out... If you want to see if people really want to buy a sustainable product price, put it in the supermarket... I would have tried to run ads and stuff and see.” [interview no.4]

Undeterred, they continued to produce the products. Around this time, two of the colleagues left to pursue other ventures, leaving just the two of them. They then decided to officially establish the company. They began with the crispbread, which they experimented with at home, and contacted a few bakeries who expressed interest until they found a recipe that was economically viable.

“We made hard bread, and everyone said this is the future.” [interview no.4]

“They [crispbread] don't have that many insects in them which to me indicates that the insect-eating is more of a religious symbol for something than an actual action that pollutes less.” [interview no.4]

They attended some fairs and tried to get their product into stores, but it was still illegal to sell edible insects in Sweden. Consequently, they established a new e-commerce company in Denmark, where selling edible insects was legal. They successfully launched their crispbread in stores in 2017. However, they could not make a fast turnover and eventually pulled the product from stores after the first delivery. They wondered about the actual motivations of customers who purchased their product—whether it was for sustainability, health benefits, or something else. They speculated that their target customers might include vegetarians seeking flavorful alternatives or bodybuilders looking for environmentally friendly protein sources. However, the high cost of insects meant that they couldn't invest much in marketing. During this period, everyone in the company had a side job and did not receive wages for doing this business. They operated on a shoestring budget with some funding from various organizations, and Interviewee No. 4 primarily managed the company. In 2018, they launched a campaign on Kickstarter to raise funds for a chocolate bar made with crickets, which was successful. They developed the recipe with the help of an expert and produced sample batches using a food producer, before finally manufacturing the chocolate-cricket bars in Bulgaria, where production costs were lower than in Sweden.

“...we did some in the bakery. I got to use their equipment off hours so I could scale it up and see what happened which made some difference. And then we used some of the producers to make samples.” [interview no.4]

Regarding sustainability, they recognized that their production process might not have been entirely environmentally friendly, given the small scale of their business. However, their focus was more on convincing people to eat insects as a sustainable alternative to traditional food sources, believing that sustainability would follow as market acceptance and supply chains developed. They considered breeding insects but thought it might be more viable in warmer or
lower-cost labor countries than Sweden. They also considered automating production, which could be more suitable for Sweden.

“We like we only focused on the first problem to get people to eat insects... And if we can get them, people to eat them, we can have people eat less CO2-polluting food, but it doesn't matter, what we do on a small scale. We flew, and we shipped crickets with planes. So, we definitely had a negative impact... It's also negligible in the broader scope like it was a small experiment that had some negative impact on the climate. Well, we learn.” [interview no.4]

Running a small-scale business presented challenges. Although there were plenty of producers around Europe, there were not many of them produce for a small-scale food company. Additionally, there were not many insect powder suppliers that met food standards, and the market was still in its early stages with few suppliers in Sweden. They eventually found a supplier in Thailand and invested all their money into ordering insect powder. Unfortunately, the supplier did not fulfill the order due to an unforeseen incident.

“I mean that's the same scale problem all small food startups have.” [interview no.4]

When asked why they didn’t apply for funding, they explained that they wanted to maintain full ownership of the business or that they desired to establish proof of concept before seeking funding.

“Sometimes my feeling is that people want to get recognition if they do something stable and they want to pay less. If they choose a sustainable choice and some people are willing to pay more, it's such a twisted sales pitch. Like, OK, this is sustainable, but I pay more or, pay less.” [interview no.4]

“...it's very confusing in terms of marketing sales.” [interview no.4]

In 2019, after operating for four years, they made the decision to close the company. As they were in the process of closing, an individual (Interviewee No. 5) expressed interest in joining the company. Consequently, they sold part of the company to him. The company produced its last batch in early 2020 and has since ceased production, though it operates in a different capacity as described in the following story.

Lastly, they offered advice to newcomers to the industry: while sustainability is important, finances are crucial. Therefore, seeking funding and investors is key. Understanding consumer preferences and researching where people are willing to pay for edible insects is essential. If there is a viable alternative, such as producing animal feed, it’s worth exploring. However, if after multiple attempts success is elusive and fatigue sets in, it’s advisable to let go of the idea and pursue a different direction.

“...kill it fast and if you don't succeed, well then maybe it holds. We tried for too long, we should have just tried to kill the idea as fast as possible because we were kind of in love with the idea of running a company...” [interview no.4]
The transition of Company D, interview no.5 (2019-present)

In 2019, Interviewee No. 5 initiated contact with the former owner of a company to learn more about it and subsequently acquired a portion of the company's shares in 2020. That same year, the Swedish Food Agency began permitting the sale of insects as food in stores on a trial basis. This was made permanent in 2021. However, Interviewee No. 5 indicated that launching a startup was challenging due to high marketing costs and difficulty attracting new investors. Although one investor invested since the former owner, it was not enough to run the company. As a result, Interviewee No. 5 decided to sell the company in October 2022 but retained the company's brand and acquired the crickets. They were motivated by an interest in sustainability and sustainable protein sources, having been inspired by an article on alternative proteins. This marked the beginning of their journey in the food industry. The decision to purchase the brand was emotional, as they had developed an attachment through working with it.

The current incarnation of Company D has been operational for less than a year and has no machinery or employees, only 3 of them including the interviewee. The other two individuals are a food engineer and a physicist. At this early stage, the company has two primary focuses. Firstly, they are exploring various suppliers for cricket powder and have begun importing from a farm in Asia due to the quality of their crickets. The company is not only seeking the best price but also collaborating with a bakery to develop an optimal recipe for their product, a type of crispbread. This will be marketed as a co-branded product.

"we're hoping for a lot of their [bakery shop] customers going to get into insects now when they see because they have it's a 20-year-old bakery and they sell like a lot already and they want to get into insects. So that's why we do need this together." [interview no.5]

Secondly, they are developing cricket bars in collaboration with their food engineer. One of the criteria for selecting collaborators is a shared interest in sustainability and enthusiasm for insects as an alternative protein source. Currently, everyone involved with the company is engaged in other jobs, with a few interns also lending a hand.

The team is working to establish a cricket farm and is actively seeking grants to fund this initiative. One of the co-owners is responsible for this aspect of the business. Essentially, they are operating two distinct ventures: one focused on food production and the other on building the cricket farm. They are initially focusing on food production as it will bolster their grant applications. The funds obtained will be channeled into building and operating the insect farm. Company D has received support from other companies within the industry. Notably, Company D doesn't view these companies or other insect-based food producers as competitors. They believe that if another company develops a delicious insect-based product, it will help build consumer acceptance for such products.

"…but like, since it's such a small business, yeah, we all know each other. And share like knowledge, whenever we can help each other." [interview no.5]
“I don't see the insect company as a competitor. The more people eat insects, it's better.” [interview no.5]

In the near future, Company D plans to distribute its products through supermarkets such as ICA and Coop, with less emphasis on online sales. They are developing a webshop but do not intend for it to be their main distribution channel. In collaboration with a bakery, they plan to use the bakery's retail presence to sell the crispbread. The bakery’s established brand and customer base are expected to contribute to the product’s recognition. They aim to launch all products within the year 2023. However, as the bakery already has a broad product range, Company D will need to actively promote the crispbread itself.

As Company D looks to scale up, it faces uncertainties, primarily in terms of financing and customer acceptance. They are awaiting grants, which, if received, will alleviate some of the financial challenges. Alternatively, they are considering engaging with venture capitalists after seeing the feedback on the crispbread in the shop. To address customer acceptance, they are producing products where the insects are not visible, such as in powder form or integrated into crispbread. Additionally, they are conscious that the higher price point of insect-based products compared to plant-based alternatives could impact consumer adoption.

“...we don't work with it in an educational way because many others do so. So it's more like having it's like an image thing.” [interview no.5]

Company D believes that its competitive advantage lies in the health benefits and environmental sustainability of insect-based products compared to traditional protein sources. They are proud to offer products such as crispbread, which are not only nutritious but also have a lower carbon footprint. They have learned from other companies that in addition to being healthy, products must also be tasty to sustain consumer interest. Similarly, for their cricket bars, they are exploring ways to strike the right balance between health and taste. One of Company D's core principles is sustainability. However, they are currently conflicted about importing insects from Asia, as this is incongruent with their sustainability goals. Hence, they are keen to establish a cricket farm in Sweden. They are also contemplating operating in a circular economy model to enhance sustainability.

“I think it's a stronger case if we have like, that's why we want the farm. We want to have it since it's a sustainability thing. It doesn't sound too well when we get the crickets from Vietnam because then you have to transport them.”

“...it's not going to be totally circular, but as circular as possible.” [interview no.5]

While they wonder if they have entered the industry too early, they firmly believe that the insect-based food market will mature, and insects will become a common food source. Although they do not know when this will happen, they are positioning themselves to capitalize on this shift. Company D is open to and encourages new entrants, as they believe this will bolster the industry and collectively advance sustainability goals.
“All the research I see is that it's a huge growing market like in the west but that's like 7 years from now, it's gonna be like 10 times as big. but you never know when. When, when, when it actually happens?” [interview no.5]

“... I hope that more insect companies will start popping up .... I really welcome that because I mean the more insects we eat the better it is the planet.” [interview no.5]

**Sustainable Business Model of Company D**

Value Proposition: The first phase of Company D's value proposition is centered around providing a sustainable and healthy alternative to traditional protein sources through the crickets product, which provided a protein bar, for instance. But in the second phase of the company, now focusing on experimenting with the new recipe of the product that collaborates with a big bakery shop.

Value Creation & Delivery: Similar to other insect companies, Company D creates value through its innovative approach to cricket as food production. They are planning to build a cricket farm in Sweden, reducing the carbon footprint associated with importing crickets from abroad.

Value Capture: Company D captures value through the sale of its cricket-based products. The company was selling cricket-based crispbread and was developing a cricket-based chocolate bar, in the first phase and focusing on the new version of crispbread in the second phase. The company operates in both B2B and B2C markets, selling their products directly to consumers as well as to other businesses for use in their products.

*Company E, interview no.6 (1980s-2021)*

Company E was one of the oldest insect-farming companies in Sweden. It began as a one-man operation that farmed insects in a basement during the 1980s. Initially, it produced insects for zoo animals, pet stores, and exotic pets. However, due to the owner’s retirement, the company was eventually sold to the person referred to as interviewee no. 6. This new owner saw the potential to scale up the business to produce food for human consumption, particularly sustainable protein. The new owner purchased Company E without any prior connection to the former owner or anyone in the insect industry, acquiring the business through Blocket.se.

“I bought, of course, everything sort of equipment and some live insects and... But I also bought of course the knowledge and experience from him and the training that I received from him that was sort of the value of the company.” [interview no.6]

The attention was piqued by a UN report which highlighted insects as a future sustainable food source, given the efficient ratio of input feed to output, which is higher than that of other animal products. Additionally, the new owner had experience and interest in sustainable agriculture and climate change, which closely aligned with their motives for purchasing Company E. They
began by constructing a small farm inside containers that had previously been used as offices. This setup proved to be effective, and a heating system was added later on. Eventually, to expand production, they rented an industrial building near their home.

“That's [construction container] sort of a low-cost start actually in that work quite good as well.” [interview no.6]

“...we started from scratch here with some live animals from the previous production.” [interview no.6]

However, regulations proved to be an obstacle. The Swedish Food Agency did not permit insects to be sold as human food at that time, although the owners remained hopeful that this would change. Consequently, they continued with the original business model of producing insects for animals. At that point, the company was farming over 10 species of insects, primarily mealworms and crickets.

With their insect business, they thought that animal welfare was also important, and insects seem to have good welfare in the container. For example, they were not convinced that pigs in cages would be accepted by customers in the future compared to today's pigs in cages. In addition, one advantage of producing insects is that insects are cold-blooded animals, so they have less activity when the temperature is low and then they go into a deep sleeping stage and die, which is a natural process.

“...I mean, in the days the insects are active and if it's cold at night, they are just sitting. And if there are a couple of cold nights, they are maybe hibernating and then they are alive and kicking again. But in the long winter, like in Sweden, of course, many of them die. So I don't think that they experience any anxiety...” [interview no.6]

As insect farming required daily attention, the owners initially hired a part-time employee to feed the insects and later added a full-time employee for production. Gradually, around eight people were involved in-and-out in the operation. The owners sourced employees through their network, ensuring that they had some experience with insects. These employees were paid decent wages as there was steady business from regular customers, including a zoo. And also, the owner was working other two jobs at that time.

“...And one of the applicants was actually very competent in this. He had for both, himself and his own needs because he had a lot of reptiles. So he had him breeding insects for like 20 years maybe, the small scale of course. But I mean, he had tried a lot of different things and he sort of knew what worked and what didn't. And it was, well, it was quite innovative and interesting...So was very good with him, I think. And I think he also developed some of the equipment that we used and so on because it's not much there is not so much off-the-shelf equipment. You have to sort of construct or build or adapt other equipment for this.” [interview no.6]
As mentioned earlier, they would like to scale up and move to human food instead, because firstly they are not interested in reptiles or zoos, and secondly, they think that insects are resource efficient, sustainable, and high in protein for human food. For example, they have tried to use the by-product of the brewing industry, known as draff. And some feed ingredient research from the university to see what the most resource-efficient feed is. While running the company, they also made some contacts with other companies in the industry, such as Company C, and with researchers at the university. There was a chef who bought the cricket from them to try cooking with. They found that the crickets had different tastes and qualities due to the different feeds. They never sold anything for human consumption. They thought that at that year, 2019, no one produced anything for human consumption in Sweden due to the regulation.

“I don't think that anyone of them produced anything in Sweden. They bought cricket flour from I think Asia and then they had some subcontractor making the crackers in a country where that was allowed and then they sort of, well, they sold them from a country outside with them to consumers in Sweden. I think that was the business model actually to work around this, I was interested in the production and the resource efficiency itself...” [interview no.6]

In 2020, when the sale of insects as human food was legalized in Sweden, the owners started preparing to sell insect flour to another company. However, they had to cease operations before reaching this stage due to financial constraints. They were reluctant to seek external funding as they wanted to retain full control of the business, but eventually realized they could not scale up with their own funds. Despite discussions with potential investors, they did not secure any investment. So, they decided to sell the company. It was difficult to sell since the operation was all manual handling, but people were expecting something more, like automation. They concluded that the manual nature of their operation and high labor costs in Sweden made their business less attractive, as investors were looking for more automation.

“And they I think they had much higher expectations around the maybe the financial, the financial side and the maybe the technological level as well because this was very manually handled by us. It was not automatized and I mean the major experience from my side is of course that it's impossible to do a small-scale company in Sweden then you should be located in a country with low labor costs, basically. And maybe a more favorable climate as well, but I think it's the labor cost actually. So I mean in Sweden the option is to raise capital and invest heavily in automation.” [interview no.6]

In September 2021, Company E ceased operations as it was unprofitable, and the owner was focused on a growing alternative venture. When asked if they would consider restarting the business with sufficient resources, they mentioned the possibility of purchasing an automated or semi-automated production system. However, they are currently content with their work in helping other companies achieve sustainability certifications, a field that has been garnering increasing interest.
“...And that could be a big advantage because then you can have many sorts of simpler facilities. You don't have to invest in a very well-insulated and heated warehouse...” [interview no.6]

“...So no. I wouldn't go back because it's a lot of work for much less money so that's basically.” [interview no.6]

Reflecting on their past venture, the owner believes they should have started on a smaller scale and invested in automation to free up resources for other aspects such as marketing and packaging. They compared insect farming to poultry farming, suggesting that a more continuous production system would have been advantageous.

“...then you can just put them [containers] in like sequences. You know that you put the eggs in one container one day and maybe a week later you put the eggs in the next one and so on. So, you have more of a continuous production. It is batches, of course, but you can put them in sequences and then you can have a continuous output and then you have time to handle the hardest, for example, and the packaging and deliveries and so on.” [interview no.6]

**Sustainable Business Model of Company E**

Value Proposition: Company E's value proposition is centered around the production of insects as a sustainable and resource-efficient source of protein. The company initially catered to zoos and pet stores. However, after being sold, the new owner aimed to shift the company's focus towards human consumption, seeing the potential of insects as a sustainable alternative to traditional protein sources. The company's value proposition is thus rooted in sustainability, resource efficiency, and the promotion of alternative protein sources.

Value Creation & Delivery: Company E created value through its variety of insect species. Initially, the company created value by providing a reliable source of insects for zoos and pet stores. After the company was sold, the company also sought to create value through its commitment to sustainability and resource efficiency, as well as through its efforts to promote insects as a viable alternative to traditional protein sources.

Value Capture: Company E captured value through the sale of its insects and the new owner aimed to capture additional value by selling insects for human consumption. However, due to financial constraints and regulatory barriers, the company was unable to fully realize this new value-capture strategy.

**Company F, interview no.7 (2022-present)**

The idea of setting up this company was from a co-founder who had been working in the food industry for over 20 years, and later had an idea for starting up the insect business. The motivation is mostly from the sustainability aspect of insects as a future food and also the alternative health-wise protein. The company was officially founded by 2 co-founders in 2022. They had been interested in the insect industry for a few years but decided to start the company
after the Swedish Food Agency allows them to sell insects as human food in Sweden. At the moment, they are working on most of the things by solely 2 of them. Before starting this Company F, the interviewee was working on a dozen of start-ups in different fields but had not worked in the food industry before.

“I was very thrilled to hear about it. And I said, of course, we must do this, and that was a couple of years back, so it’s only one year that we have been doing this. We’re very young as a company.” [interview no.7]

They aim to market their product as a smart protein that can easily be incorporated into everyday diets. They are also contemplating supplying their product to public institutions such as schools and hospitals, as well as facilities that require high-protein diets, like care centers. Moreover, they evaluated several suppliers from different countries, including Norway, Lithuania, and Portugal, before ultimately selecting a Swedish supplier with whom they commenced working on mealworms, following some research. Their choice to focus on mealworms was influenced by a couple of factors: firstly, having a local supplier in Sweden makes operations more manageable, and secondly, mealworms are versatile in terms of applications. For instance, mealworms can be effortlessly utilized to produce minced meat, while other insects, such as crickets, are more challenging to process due to their exoskeletons, wings, and other features. Consequently, the ability to produce minced meat from mealworms may serve as one of their competitive advantages, enabling them to offer distinct products compared to other companies.

“…most of the companies in the insect industry are doing more like… dry products or like… bars and snacks, and we want to do the mince and it's not that many...” [interview no.7]

The company was recently founded, so I inquired about the barriers or challenges they have encountered thus far. They believe that gaining customer acceptance is a hurdle they need to overcome, and they think it might even be too early for the market. However, they also identified several driving factors in this industry. Firstly, the sustainability aspect of using insects as a future food source is a major catalyst. Secondly, collaboration among alternative protein companies could make consumers more cognizant of the entire food system and open to change. Presently, they are joining and becoming part of a network for insect-based food in Sweden, in an effort to collectively pursue shared objectives.

“Seems like it's not so much competition. It's more like we want to work together and there's enough market for everyone, I think.” [interview no.7]

At the moment, they are devoting part of their time to this company as a side project, as they both have other employment. They began by experimenting with recipes for two products; one is minced meat made from mealworm larvae, and the other is granola made from mealworms. They hope to launch these products in the autumn of 2023. The knowledge they use, such as the recipes and types of insects, is self-acquired and exchanged between the two partners, as well as insights from the co-founder who has a background in the food industry. Financially,
they received some funding from an incubation center, but it was modest, so they largely finance the venture themselves through their other jobs.

In the near future, they will launch their products which they frame to be premium products but price-wise so they cannot be expensive. Additionally, regarding the future of the Swedish insect industry, they concur that the integration of robotic systems could be highly beneficial for improving efficiency and quality. Finally, they offered a piece of advice for newcomers to the industry: they suggest that it might be advantageous to explore creating products that have not been attempted before.

*Sustainable Business Model of Company F*

Value Proposition: Company F's value proposition is centered around the production of insect-based food products, particularly mealworms, as a sustainable and health-conscious source of protein. The company aims to market its products as a "smart protein" that can be consumed as part of a regular diet. They are targeting a wide range of consumers, from young urban men to public institutions like schools and hospitals. Their products are designed to be premium yet affordable.

Value Creation & Delivery: Company F creates value through its unique insect farming operations and product development. They have chosen to work with mealworms due to their ease of operation and suitability for creating minced meat products. They source their mealworms locally from a Swedish supplier, which not only supports local businesses but also reduces the environmental impact associated with long-distance transportation.

Value Capture: Company F plans to capture value through the sale of its insect-based food products. They are currently in the product development stage, experimenting with recipes for two products: minced meat from mealworm larvae and granola from mealworms. They plan to launch these products by 2023.

*Company G, interview no.8 (2018-2021)*

The journey started with joining the one bug banquet the internal organization, held by the university, in 2017, which aims to promote insects as a sustainable food. There was a presentation from an insect start-up company that talked about all the benefits of turning insects into new protein sources, and then provided three-course meals made from insects. They [interviewee no.8] were curious and would like to know more about this novel industry. From that event, they believed that the edible insect industry will grow up in the near future.

“... I've always been the kind of person that... like... I am passionate about novelties, and I was curious about it.” [interview no.8]

They took the initiative to conduct research on their own, mapping out all the active insect companies in Sweden at that time. They then entered the industry by taking an internship at
Company H and authored a thesis paper on the consumption of insects in the same year. Their thesis examined how to overcome the barriers in this industry, such as regulatory hurdles and the negative perception associated with eating insects. They aspired to normalize the consumption of insects.

“...like now [2017] that there is also like this...this shift in regulation, I think that there is still an approach to it from the market as like let's try it, it is cool. Let's try one...one more time, but my interest was like how can we make it to make it become a habit? makes it become normalized.” [interview no.8]

Despite their interest in the industry, they did not initially consider starting their own business. Instead, they focused on research to understand and address the challenges facing the insect consumption industry, as documented in their thesis. They presented their thesis at the INSECTA conference, one of the largest insect-related conferences in Europe, where they received an award for best presentation. Subsequently, in 2018, they joined an incubation center to develop their business idea. They were aware that Denmark had already started selling insect-based food products at that time and anticipated that Sweden might follow suit. They began developing ideas and experimenting with recipes for high-protein snacks targeted at individuals, such as sportspersons, who require additional protein. Initially, they sourced cricket flour from a company in England, but due to Brexit, they switched suppliers to a company in Denmark. However, this supplier ran out of cricket flour, and they had to settle for mealworm flour. They observed that different insect flours imparted distinct flavors, with cricket flour being preferable. When asked why they didn't source the flour from Sweden, they explained that producing insect flour for food purposes was not yet permitted in Sweden, and importing from Asian countries was too expensive. Additionally, they only needed a small quantity of flour for experimentation.

“...but for some time, I also... you know...thought of maybe I could get into it actually starting the company and producing insect flour because that is a better option... as you can always have... if you divide, you can always sell insects for making animal food, and then you can also have that as a... It's another business option, let's say.” [interview no.8]

I then asked about the aspects of the distribution channel and customer. But since they stopped before reaching that stage, it was a plan that they would like to focus on both B2C and B2B customers which might be distributed through an online shop or with partners, that was the aim. After trying for years, unfortunately, the insects were not yet allowed to sell as human food in Sweden at that time. They were tired of fighting for something that might not be possible to do. Eventually, they decided to shift their focus.

“I started to develop my business idea, the only problem is that I started at the worst time...I was like trying to maybe just develop my idea, my brand, and everything, but at the end of the day, I mean, if you don't have any possibilities to sell your product. Then it becomes really tough, right?” [interview no.8]
Currently, even though selling insects as food may be allowed in Sweden, they believe there are greater opportunities for using insects for pet food. They still see value in promoting insects for human consumption but recognize it's a challenging path. They strongly support the movement to normalize insect consumption in the West, as it is not a new concept, but has been practiced in various parts of the world for centuries. It's merely new to the Western world.

“It's tough to make people in the West, at least have them get used to the idea that this is OK and that you can eat insects as part of your daily diet.” [interview no.8]

“Of course, people would make a one-time purchase or twice just for fun. I think that this is the kind of opportunity there is as of now, but I might be wrong, I don't know.” [interview no.8]

“...I think we're trying to create the hype about something that is so normal in other parts of the world.” [interview no.8]

Apart from the regulation in Sweden and customer acceptance, there were other barriers to their business path. The finance was, of course, something that many start-ups including their company were facing. On top of that, the fact of being a non-Swedish entrepreneur in Swedish business was not easy for them. However, they said that in the Netherlands there is a university that provides a course about insect-eating and how to run the insect business back then. It was a good opportunity for them to join that. They also got a scholarship while studying for a master’s degree, but I was not enough to set up a limited company.

“I could not really sell anything to prove that my business idea was valid... And I actually had many discussions about it that I needed more of this sort of knowledge back then...” [interview no.8]

“...having access to something like that [the insect business course] would have been amazing for me.” [interview no.8]

In Sweden, they believe that certain actions taken by entrepreneurs could potentially hinder the progress of the insect industry in achieving its common goals. As mentioned earlier, they agree that insect consumption should be normalized and that insects should be seen as regular food items for people to consume.

“In all the other entrepreneurs, if they still make it something spectacular, we're not really achieving our goals. We are pushing, pushing the, the, the goal farther back.” [interview no.8]

Now that they are no longer students, they are not eligible to remain in the university's incubation center. However, they have maintained connections with individuals in the ecosystem, such as those at Drivhuset. Consequently, if they wish to leverage these connections to restart the company, it is a viable option. They expressed that they enjoyed being entrepreneurs, especially in the insect industry, and that they may consider re-entering this
field. Despite not achieving success in their venture, they take pride in the journey they undertook and continue to be engaged in sustainability efforts in Sweden.

“...I think it's for me it is a good achievement to say that I was one of the first ones to push into access food in Sweden.” [interview no.8]

In conclusion, regarding the future direction of the insect industry in Sweden, they suggest adopting a circular approach. Insects possess the potential to transform the food system. However, continuing to follow traditional methods and creating a single structure or system for the insect industry would not be the right way forward. Instead, it is more advantageous to utilize insects as an opportunity to reevaluate and reinvent our food system.

Sustainable Business Model of Company G
Value Proposition: Company G's value proposition was centered around the promotion of insects as a sustainable and novel source of protein. They aimed to normalize the consumption of insects in the Western world, where it is not a common practice. Their goal was to develop high-protein snacks targeting individuals who require extra protein, such as athletes.

Value Creation & Delivery: Company G created value through its research and development efforts. They conducted extensive research on the insect industry in Sweden and experimented with recipes for insect-based foods. They also aimed to create value through their advocacy for the normalization of insect consumption. They believed that insects could be a sustainable and health-conscious source of protein and aimed to change public perception about insect consumption.

Value Capture: Company G faced significant challenges in capturing value due to regulatory restrictions in Sweden. They were unable to sell their insect-based products, which limited their ability to generate revenue.

Company H, interview no.9 (2017-2020)
The company's journey started in 2017, with a good relationship with two colleagues from the same master’s program in sustainable development. A few years after graduating, these two colleagues met and talked about starting a new business together that was innovative. One of the co-founders had been working within the food industry before, so they had some experience in food. And another co-founder had experience in a couple of start-ups. They thought about starting a sustainable protein business as the market was growing. At first, they had ideas based on plants, but after brainstorming they decided to work with insects instead.

And that was where the journey began. They chose cricket mainly because of its high amino acid protein content, low water and energy consumption, and the fact that it can turn waste into a nutrient-rich resource.
“…it was a good opportunity for many reasons. I mean primarily this sustainability aspect of protein... we were very fascinated about the low consumption of water and energy in order to produce these proteins...” [interview no.9]

In the beginning, they experimented with the recipe for the variety of food between the mealworm and the cricket flour, but it turned out that the cricket was more flavorful than the mealworm. This, combined with the fact that crickets consume more waste than mealworms, made crickets the perfect choice. At the same time, they were producing the brand, they were also thinking and learning which type of product would be profitable to put into the market. Finally, they decided to make the crispbread with cricket flour. They were not running the business on an industrial scale but working together with a professional chef. There were not many people involved in the company at that time. There were two co-founders and an intern student who were involved for a few months.

“…it got very exciting because the crickets flour was very versatile in the production of food and the content of protein was extremely high. So, we went for it and we started building the brand.” [interview no.9]

When starting to import the cricket flour, they got to know a Finnish company that produced a full complete production system in one container cube. They have talked once in a while with this company and shared some ideas with them. So, the Finnish company gave them a contact of the cricket flour supplier in Thailand. After that, they first ordered from Thailand where the long story of insects is. Then, they moved to order from a Danish company, but then the Danish company started importing from Thailand later. They made about a hundred to start with and took them to a couple of fairs to do some initial testing. At the fair, people walked around and were excited to try their crispbread, and they got positive feedback from the people who tried it. They also realized that they were not just a player in this industry, so they wanted to position their brand differently from others.

“…but most competitors are going for the green-friendly, happy branding so most commonly you will find you know a green logotype with happy cricket, and the name will be tricky.” [interview no.9]

So, they decided to put the brand in a premium position, for example, they designed the packaging with high-quality materials and tones of color that represent premium by outsourcing a consultant who helped with the branding. Of course, they said that the cost of doing that was high and it was difficult for people to pay for it. They tried to sell to the initial group first, for instance, family, friends, and in some fairs. They also got some orders from Denmark and Finland from the corporate that wanted to try the innovative product. Although the product was appreciated by very few people, they were still in the marketing phase.

The barrier started in 2017 when they were not allowed to sell insects as food in Sweden. Then, they thought that they might possibly sell in Denmark instead. However, they asked the Swedish Food Agency, and the answer was no, they could not do that and needed to wait for
the regulation to be approved by Sweden. Together with other companies, they sent a couple of letters to the Swedish Food Agency to push up on implementing the European Regulation in the country, but it was too late for them.

“…we [Swedish insect companies] were a bit competitor and a bit helping each other because we know one of us had access to the market. We were just trying to sell, but we couldn't sell, so we were friends before being enemies, but all great people. I mean, I liked them because they were sharing news about the regulations, so it was very cooperative in that sense.” [interview no.9]

Although it was possible for them to shift their focus to animal feed or fish feed, it was not their interest. They decided to close the company in 2020. Shortly after closing the company, insect as food was allowed to be sold in Sweden.

“…So they [the Swedish Food Agency] said you cannot put it in the market. You need to wait. So, that kind of stopped everything... it was a big hit for the company, so also motivation started going down and I think that was the beginning of the end... ” [interview no.9]

I then asked about their business plan back then. The plan was to set up the cricket farm and feed it with food waste. Unfortunately, all plans were stopped since they could not get into the market. They plan to run the farm with a circular business model where they would source food/ food waste, basically super low cost. Then use their capital to grow the insects or heat energy and lastly hire employees to take care of the farm, but also aim for the automatic system if possible.

“...And then sell it with a high margin and as a human food, of course, it was a long, long journey.” [interview no.9]

In this journey, there was support in the form of small grants from innovation or start-up organizations. It was not much for them, but they managed to cover some outgoes. Apart from that, it was mainly their own funding. Backed in the first batch of production and shipping the cricket flour from abroad, it did not cost much so they did pay by themselves. But the next step to enlarge the production and build up a plant to grow cricket was high, so they applied for the mentioned grants.

“...of course, it's not really sustainable to ship in this protein from another country. It should be done locally, but in order to get the money or to get the...OK, we do this, we want to test the market. So, the best way was to import it in this phase.” [interview no.9]

They told us about something that happened lately around the insect-eating industry. There was a big debate in Italy at the moment about cricket flour because some companies were putting cricket flour in food and selling it. But when the customers realized that they were eating insects, they said: ‘There's no way we want to eat insects.’ So, the minister stopped all products containing insects and set the standard that all products must be labeled if they contain insects.
Insects are now something legal in Italy, but still not a big thing. Although there has been a lot of discussion about eating insects, there is no big company in Italy that does it.

Lastly, from their perspective, building a brand is difficult. Therefore, they suggest the new entrants build up relationships and find good deals with B2B rather than going directly to the customers. And today, it is easier within the regulation and legal aspects, so they would like to encourage you to try.

“I wish I started now to do this and... I think maybe... I wouldn’t go as luxurious as we went. I will go a little bit more approachable but still don’t go for the cheap market segment because I don’t think that that’s where this type of product will take off.” [interview no.9]

Sustainable Business Model of Company H

Value Proposition: Company H’s value proposition was centered around the promotion of insects, specifically crickets, as a sustainable and high-protein food source. They aimed to create a premium brand that offered high-quality, cricket-based products. Their primary product was a crispbread made from cricket flour, which they positioned as a flavorful and sustainable alternative.

Value Creation & Delivery: Company H created value through its innovative approach to food production. They experimented with different recipes and ingredients, ultimately choosing to use cricket due to its high protein content and sustainability benefits. They also created value through their branding efforts, positioning their products as premium and high-quality. They worked with a professional chef to develop their recipes and used high-quality materials for their packaging.

Value Capture: Company H faced significant challenges in capturing value due to regulatory restrictions in Sweden. Despite their efforts to promote and sell their products, they were unable to do so due to regulations prohibiting the sale of insect-based foods. This significantly limited their ability to generate revenue.

Company I, interview no.10 (2014/2015-present)

[Company I is a house cricket (Acheta domesticus) breeder, which was founded by 2 researchers. The company has a motivational vision of providing productive house crickets as a healthy and sustainable food. The company acts as a supplier that provides house crickets bred for productivity to insect farms or insect-based food and feed company. All house crickets are tested and free from one important virus, the Acheta domesticus Densovirus, and food-borne pathogens (Salmonella, and Aspergillus). Apart from house crickets, the company also provides lab analysis if the insect farmers or the food producers would like to examine if their insects carry densovirus or some other viruses or food pathogen.]

I had a good opportunity to talk to one of the founders. With their background in conservation biology, they have been working on different species and types of animals, including insects.
They teamed up with other researchers from the same university and started working on the insect-rearing project about 8-9 years ago. One of the results of the research was that rearing insects could be of commercial interest in Sweden, as it is in many countries in Asia. After running the project for a while, they decided to set up the company with a close colleague who had expertise in animal science. They thought that the insect breeding business was an opportunity because other farm animals like pigs and chickens have breeders, but the insect industry has very none, and they saw that this industry was going to grow a lot in the future.

“...there are super large companies that provide all farmers... in most countries in Europe and North America, they don't have their own breeding animals [e.g., pigs and chickens]. You buy every year your animals and then you raise them... so this is sort of something similar that is likely to be needed for the insect industry. So, we saw a future sort of hole where this would fit in.” [interview no.10]

They then got some help and funding from the university and concentrated on one species of insect, the house cricket. One of the reasons for choosing this species is that it has high nutritional value for humans and is also rich in flavor. And this species is found in many areas around the world, so they do not have to worry too much about invasive problems. These reasons are the core of the business to find and breed a species that is sustainable for the world. Mealworms and house crickets are among the insects considered native, but the black soldier fly (BSF) is not.

From their perspective, it is important to use native species to prevent invasive problems. For example, invasive species can destroy native flora and fauna and can be vectors for diseases that can later affect entire ecosystems. Invasive species are a very large global problem and insects are one of the many groups that are spreading. So there is a risk that also insect farms could contribute to this problem. Another thing is that there are very few regulations today that cover and regulate activities in the insect industry, and this has also caused problems. The large-scale movement of insects, for example from countries with no regulation or restrictive laws. This can lead to disease and serious problems. As mentioned, the house cricket is a native species here in Sweden, so the first insects in the project were caught in the wild.

“...no one regulates the comings and goings of insects, but I've seen it's on the in the pipeline that insects will start to be regulated and ever heard also in North America. This will start to be regulated because they see all the danger of the insects being shipped back and forth...” [interview no.10]

To keep the house crickets healthy and free from disease, they have implemented a screening program and a breeding program. This allows them to monitor and track the insects for any abnormalities or common pathogens in the insects' bodies. Additionally, they closely control the temperature and the feed given to the insects. The feed is predominantly produced in-house through research and is customized according to their needs. This approach sets the company apart from other breeders who often simply move and sell insects between companies, which can potentially facilitate the transfer of pathogens. This issue is not limited to Sweden; it is
prevalent in many countries and is indicative of an industry that is still in its nascent stages. Moreover, most of these activities are carried out by small companies or start-ups, which contrasts with larger companies that have dedicated staff or teams addressing these issues.

“...when they [insects companies/ farms] sort of feel like maybe something is not looking so good here, maybe I should get some new animals. They maybe get from a colleague in the same within... you know... in the same country or something just trade... trade individuals, which potentially could work or could not work, depending on if they are sick or from the beginning came from the same family...they are just basically trading cousins... So, I think that's what many are doing, and that I think... that is an indication that the industry is pretty young because there's not so much understanding in how you do it professionally.” [interview no.10]

Therefore, the company aims to sell house crickets parents to farms from time to time. This means that the crickets on the farm will not have a problem with inbreeding or preventing the crickets from reproducing in the same family, which could later lead to a reduction in genetic diversity. With less genetic diversity, the crickets or even other animals could have various effects, such as being smaller, unhealthy, and so on. And with the company's breeding system, they could track and know the heredity of the crickets and prevent all these problems. They keep breeding and selecting all the time to increase diversity and have a suitable large population. Moreover, they also provide advice to the customer and keep checking the health of customers’ insects and analyze the pathogens if exist. So, this is a kind of aim to have a close relationship with the customers.

“...we can keep track of everything what we sell and what they had before and so on. So, it's sort of a more sustainable solution if you want to optimize the quality and the output for your companies.” [interview no.10]

As the company was founded at a time when other insect companies were struggling with the Swedish regulation that insects could not be sold as human food, we asked them if they were affected by this regulation. They said that it was an indirect effect, as they somehow lost potential customers, as many companies closed down during that time. They also reflected on the fact that Sweden was and still is a small insect industry compared to other European countries. However, they have customers around the world as long as the customers can import them, and not only just in the food section, but some customers are also in the feed section such as fish production. In addition, their crickets can be delivered in any stage of the life cycle, whether in the adult stage or nymph, as a match to the purpose of use from the customers.

“...we see in terms of new companies starting as I think they start everywhere... you know...more and more and in all... everywhere in all the continents... around the world. There are new companies coming up...” [interview no.10]

At present, the company is seeking additional funding to scale up production by expanding its workforce and network. They are interested in establishing hubs in other regions globally, as they are currently geographically distant from many countries, particularly those in Asia. With
regard to funding, they believe that attracting investors from outside Sweden may be feasible since the industry in Sweden is still nascent, and domestic investors may not fully grasp the potential for expansion and the nuances of the company.

Lastly, they want to emphasize one crucial aspect: businesses in the insect industry must possess the requisite knowledge for success. This includes an understanding of the types of food and heat sources that are both sustainable and economically viable. It is imperative to identify sustainable solutions for both components from the outset; otherwise, achieving profitability may prove challenging. Furthermore, they are optimistic that the consumption of insects, especially mealworms and house crickets, will become increasingly commonplace.

“...how you're going to provide the temperature that they need since we live in a country that is cold most of the year, and they need... energy costs are... you know... increasing in most parts of the world. So, you have to find a system where you can utilize heat or electricity from a source that won't cost you so much.” [interview no.10]

*Sustainable Business Model of Company I*

Value Proposition: Company I's value proposition is centered around providing healthy house crickets selected for production for insect farmers that in turn rear insects as healthy and sustainable food sources. Their animals do not carry the densovirus or other common food-borne pathogens, making them a reliable supplier for insect farms or insect-based food and feed companies. They also offer lab analysis services for those who want to examine if their insects carry some common viruses and pathogens.

Value Creation & Delivery: Company I creates value through its unique focus on breeding genetically improved house crickets. They have a screening and breeding program that ensures the health and quality of their house crickets, which are produced in-house and customized by themselves. This attention to detail and commitment to quality sets them apart from other breeders. They also create value through their commitment to sustainability, choosing to breed house crickets due to their low environmental impact.

Value Capture: Company I captures value through the sale of their house crickets to farms and insect-based food and feed companies. They also generate revenue through their lab analysis services. Despite regulatory challenges in Sweden, they have been able to capture value by serving customers around the world. They are also seeking additional funding to expand their operations and potentially establish hubs in other parts of the world, which could further increase their ability to capture value.
Company J, interview no.11 (2014/2015-present)

[This is an interview of a research and development project in one company that is interested in the insect industry in Sweden, which mainly focus on insects as feed production. The interview was conducted with 2 participants at the same time. So, 'they' represent the project, not the whole company.]

The project's journey began when they recognized that biogas was not a viable path for the company and that the company had an abundant supply of organic materials. They initiated research to explore other opportunities that could potentially enhance the value of their organic materials more effectively than biogas. Around 2014 or 2015, they discovered that the black soldier fly (BSF) might be an excellent option for managing these materials, and this marked the inception of the project. They conducted numerous laboratory-scale experiments with various types of organic materials to determine which ones were best suited for BSF. Concurrently, one of the project's collaborators was working on a Ph.D. thesis on insects and acquired the first batch of insects for both the thesis and the project from the Netherlands. Subsequently, as regulations became more relaxed, the project began sourcing insects from within Sweden.

“...so it's been a bit of curiosity and looking at how the technology works, but also further along we get and understanding how the economic side of things look especially with operating costs and capital investment.” [interview no.11]

One of the major driving forces behind this project is the increasing demand in the Nordic countries to import animal feed from other countries, be it soya or rice. On top of that it is possibly helping to reduce the greenhouse gas emission from producing these traditional material feed supplies. And choosing for doing food industry or insect as food is a bit far from the company's core business which is mainly focused on recycling and material production, and the company has been doing biogas for quite a long time. So, this is the reason for choosing to research the feed industry.

Now, they are in the demonstrational stage of a research and development project looking at sustainable protein production in insects, especially in BSF, from the organic material that is now classified as waste. They are experimenting with different materials and recipes that can boost up a robust system, so they are aiming for various upstream supplies. Moreover, they are trying different steps to know how they can improve efficiency and reduce the time and cost of spending in both upstream supplies and products downstream. The collaboration has been seen in the research and experimental stage with their partners. For example, they provide feed to partners in fish, chicken, and pig production. They also want to work with a completely sustainable cycle for the animal that will eat feed from insects. It does not have to be entirely insect feed but can be mixed with other types of feed if it is more sustainable. However, from their perspective, insects as feed are not a new thing, it has been studied in several areas, but it is just the scaling up part, for example how to make the most efficient resource when scaling up.
“…we want to be able to work with diverse upstream flows to mitigate the risk of not having enough material to meet the investment that you made.” [interview no.11]

Since they are trying various recipes of insect feeds, one thing to be considered about the regulations of the feed. There is the animal by-product regulation (ABP) and the regulation on what you can feed animals. So, everything that comes from the restaurant, slaughterhouse, or anything including meat are not allowed to feed insect, but you are allowed to take from food products such as potato peels, and juice pressing. The reason is to prevent the transmission of diseases. But this is a barrier since the food waste that is allowed to feed insects is less portion compared to all wastes including the majority from households. Therefore, scaling up the product will be difficult.

“…the non-ABP it's hard to say exactly how much there is because a lot of it's classified as a by-product or co-product, so it's not reported in, you know, waste statistics.” [interview no.11]

“…that's a bit of a barrier is if you want to do large scale, you would probably want to go for this household waste” [interview no.11]

“There's some grey zone as well with, like the stuff that's coming from grocery stores and warehouses. If you know it's not an ABP, can you use it in Sweden? They haven't really laid down the lines on that yet. Norway's come a bit further.” [interview no.11]

Another barrier could be resources, budget, and labor. They gave an example that if the company wants to initiate small-scale production, implementing a robotic system is prohibitively expensive, but hiring personnel in Sweden is also costly. Consequently, the labor cost for small-scale production emerges as a barrier. Since this endeavor is a demonstration project within the company, and not a company exclusively focused on insects, they employ both permanent staff and contractors. Nevertheless, it is a relatively small project with few people involved, primarily operating on a laboratory scale. They receive assistance from some Ph.D. students in the lab and collaborate with universities in the United States. Thus, the operation primarily follows a hybrid approach. They aspire to incorporate an automated system in the future to scale up production, but at the demonstration stage, a hybrid system is more suitable. Regulations surrounding food waste present another obstacle, as a substantial portion of the potential supply remains unusable. Conversely, an impetus for this venture is the escalating demand for protein consumption, which in turn signifies an increasing need for feed. They are optimistic that this demand can reduce the production costs of insects as feed, making it more viable through strategies such as decreasing the cost of organic material supply or garnering support for this alternative feed.

Despite being a small project, it is part of a substantial company with extensive experience and connections, particularly in materials and waste management. They handle millions of tons of waste annually and have insights into the types and origins of the waste supply. This could be viewed as one of their strengths, as they have capabilities beyond what most start-ups possess. However, this can also be a double-edged sword. As a large company, they have multiple
priorities simultaneously, and not all employees can dedicate their full attention to this project. This contrasts with other insect-focused start-ups that concentrate solely on insects. Consequently, it can be challenging for them to make rapid progress in any single domain.

“…compared to a company, maybe that’s funded by investment capital, we have a lot more long-term willingness, as you can see, this project’s been going for a long time. If we were a start-up, I don’t think we would still be a start-up doing what we’re doing today.” [interview no.11]

“…there’s no existing strategy in our strategy, a lot of maybe the start-ups you talked to, I don’t know if they’re talking about existing strategies and such, but for us, we want to have operations for several generations to come. We don't really wanna like to develop something and make a quick buck and move on to the next thing we want it to be sustainable in, in the sense that you know the next generation of ...[the company]. people and the next step that can have something to work with.” [interview no.11]

Finally, I am excited to see how this project will develop shortly, it could be a big change in the insect industry if a big company becomes one of the players in this industry.

Sustainable Business Model of Company J

Value Proposition: Company J's value proposition is centered around providing a sustainable solution for the management of organic waste through the breeding of BSF. They aim to transform organic waste into a valuable resource by using it as feed for BSF, which can then be used as a sustainable source of protein for animal feed.

Value Creation & Delivery: Company J creates value through its innovative approach to waste management and sustainable protein production. They are experimenting with different materials and recipes to optimize the growth and health of their BSF. They are also working on developing a robust system that can handle diverse upstream flows, mitigating the risk of not having enough material to meet their investment. Their commitment to sustainability and efficient resource use sets them apart from other companies in the industry. They also create value through their partnerships with universities and other organizations, which provide them with valuable resources and expertise.

Value Capture: Company J captures value through the potential sale of its BSF as a sustainable source of protein for animal feed. They are currently in the demonstration stage of their research and development project, but once they scale up their operations, they could generate significant revenue from the sale of their BSF.
Their journey in the insect industry began as a result of competition within a journalist community that challenged them to write 100 blogs in 100 days consecutively. While searching for a plethora of topics and ideas to fulfill this quota, they stumbled upon the topic of insect consumption in an FAO report from 2013, which they found both intriguing and stimulating. They corresponded with numerous individuals globally who were enthused by this FAO report. After writing a couple of blog posts about the edible insect and the edible insect movement, they decided to open up the website. The website was inspired by an individual who traveled and blogged about hamburgers, gaining popularity and amassing a following that eventually funded the opening of a burger restaurant.

“...but quite, uh soon I realized that I didn't like the idea of selling insects [by themselves].” [interview no.12]

In 2014, they approached companies in Sweden that had begun selling insects as food and were preparing to debut new products. However, they discovered that the sale of insect-based food products was prohibited. They said it was important to put restrictions on food after the transmission of mad cow disease. Then they told us a timeline regarding what happened and the reason why the Swedish Food Agency did not allow insects to be sold as food in Sweden, while some of the European countries allowed it. It was intriguing to note that many EU countries had different interpretations regarding insect consumption under the Novel Food Act. Some countries interpreted normal food within the Novel Food Act as ingredients, but regarded insects as whole entities, meaning that even in powdered form, insects were still considered whole. The earlier version of the Novel Food Act did not encompass whole animals; it was directed toward ingredients or new types of food. One point they found noteworthy was that the Netherlands, the UK, and Belgium, countries with colonial histories and immigrant populations familiar with insect consumption, were among the first to allow the sale of insects as food.

“...often people that are quite like maybe...70-80 years old and they talk about...I remember when...when...when you could buy it in shops like .... the ants ...stuff like that... because it has been sold like a curiosity in Sweden.” [interview no.12]

The Novel Food Act was interpreted and implemented divergently among EU countries. The companies that had been selling insects were allowed to continue doing so, with the period leading up to January 1, 2018, designated as a transitional phase. Interestingly, EU member states had varying interpretations of the Novel Food Act. The authority to permit or prohibit the sale of insects as food was vested in each country. Denmark was one of the countries that permitted it, but Sweden was not. In 2017, insect companies in Sweden endeavored to persuade the Swedish Food Agency to adopt the transitional rule, but this effort proved futile. Subsequently, in the fall of the same year, Finland authorized Finnish insect companies to adhere to the transitional rule. In December 2017, there was anticipation that Sweden would permit the sale of insects as food, but the answer was negative, citing health concerns. As a
result, most Swedish insect companies withdrew from the industry, leaving only two companies, Company C and Company D. Meanwhile, Company B established production facilities in Thailand.

In 2020, the European Court ruled that whole insects were not included in the old Novel Food Act, meaning that Swedish insect companies could have legally sold insects as food in Sweden before this ruling. Following this, Sweden eventually adopted the transitional rule in 2020.

“...when that happened [the Denmark and Finland cases] we really thought...like... you [Sweden] can do the same as we have Denmark, we have Finland. Why can't Sweden?” [interview no.12]

During the time that it was a chaotic regulation, the insect companies were gathering and creating a community called Insektsföretagen to share their knowledge and convince the Swedish Food Agency. And it was only two members left after all had quit the industry due to the regulation. However, they are building up this community again since there are new actors these days. It is showing that all players are trying to build up a good relationship to help this community grow.

“...it is important to cooperate and help each other so there's no one that thinks like, wow, I'm the first. I have this secret sauce or a secret like this...It's quite important...at least at this stage to cooperate. So, everyone was really happy with this, and uh, we're going to have this meeting in April.” [interview no.12]

I then asked their opinion on the customer side such as open acceptance of consumers. They mentioned a reason that might be a problem, is that the allowance to sell insects as food in Sweden was launched during the pandemic. So, most of the business partners, for instance, restaurants, shops, or investors, were also struggling with their situation to survive during that time. That is why today there is no product in the market that we can see noticeably. In the aspect of the customers, the insect market in Sweden is still niche as they asked and talked to people, but some replied and were surprised that insects are edible.

“It's still extremely novel in Sweden, and I'm surprised for me...is that there are still people I meet who sort of get surprised by their oh! eating insects or... it's a crazy idea.” [interview no.12]

As a journalist, they talked to many insect entrepreneurs and also wrote a book about the path and situation around insects as food mainly in Sweden and other Nordic countries. They also added some recipes as ideas for cooking food with insects. In the blog they wrote about insects, some commented that ‘they will never eat an insect, they will rather be a vegan.’ So, they think that it might take some more years to have the insect industry successful, and when it succeeds, we can compare it to the success of seafood, which is also food that Swedish people do not eat often. Moreover, they also reflected on the issue that someone is afraid that the companies might put insects in food without informing them about the package. They think that it does
not make sense to hide insects since insects these days are extremely expensive, and it will up the cost of the companies if they add the insects.

“...I think a lot of entrepreneurs as we call them ENTOpreneurs, is really funny, but...a lot of people have sort of got into the business both have an idea of how to sort of save the world, but I also really like the challenge that it's quite a big challenge. They know that this is a crazy challenge. It's not like...you're not sort of work working into an existing market. You're creating a new market, uh...” [interview no.12]

“I think the problem is that people want to keep sort of standing up for I have to, I eat meat, etcetera, etcetera. It's sort of a way of sort of the traditional, it's sort of a part of the meaning of life is living this life I live now, and someone is trying to change it...” [interview no.12]

One thing we talked about during the interview was their reflection on the sustainability of insect production in Sweden, the circular system, for instance. When it turns to Sweden, of course, the temperature and energy consumption come to be one of the important aspects to consider. They think that there are ways to find sustainable heat resources for insect production such as the data center which releases lots of heat energy, or self-sustaining such as solar panels. And another aspect that is sort of a Holy Grail for this industry is the insect feed. They agree that it would be good if the companies could use the leftovers to feed insects. They gave an example of one big brewery in Sweden that has lots of draft from the production which now experimenting with one insect company feeding the insects and found that it works to feed the insects.

“...the Holy Grail of the insect industry...it's trying to find...to fit in a circular system where you can get the feed from something that's sort of leftovers that are not used in other ways, and also get the heat that is leftovers. And then when we produce the insects also what's called the frass, the sort of insect poop that can use as fertilizer.” [interview no.12]

It is intriguing to speculate how the Swedish insect industry might have evolved had it not been for the regulatory hurdles it faced in the past. A clearer picture might emerge if we examine Finland or Denmark, which began complying with the transitional regulations earlier than Sweden did. In Finland, as soon as insects were legalized as food, numerous companies rapidly launched their products, which appeared on the shelves of many stores around Helsinki. However, these products did not remain on the shelves for long. They also shared that they attempted to purchase a pack of granola weighing 200 grams, which contained approximately 15-20 crickets, and it cost 9 euros for one pack. One conspicuous reason for this was the excessively high price. Upon reflecting on the prospect of repurchasing, they could not find a compelling reason to spend 9 euros on a pack of crickets again. One observation they made from tracking the journeys of various insect companies is that these companies should initially target a niche customer base. They should begin by identifying a niche product, starting on a small scale, and ensuring that the pricing is reasonable. There have been numerous instances where companies have attempted to stock their products on shelves but were unable to maintain consistent supply due to inadequate production capacity and poor cash flow.
“...but it was quite pricey and I would say like most of these products that were sold, they had quite high price points and people sort of bought it once, thought it was fun and they didn't buy it again...” [interview no.12]

“I think it would be sort of low volume and a slow-growing market... It wouldn't be big business, but it would. I think it would be sort of a niche thing for a couple of years...” [interview no.12]

One last thing I asked them about is their journey in the future insect industry. They said that they are now working as a supporter in an organization that helps in the food sector, and they are happy with this position. They know that working with the food industry has a lot of regulations to follow and it is not easy for entrepreneurs, so they are impressed with the companies that are still doing it.

“...I'm not an insect farmer. I've tried to farm insects myself... I'm not an insect cook either... I'm more of a storyteller... I want to support you guys who are working with this...” [interview no.12]

4.2 The synthesis of the analysis

4.2.1 Sustainable Entrepreneurship and sustainable business model

As Walley and Taylor (2002) studied the internal aspect of entrepreneurs and stated that it is an important aspect to consider when assessing whether there are truly sustainable entrepreneurs. In this thesis, I found that, firstly, most of the companies that are involved or used to be involved in the insect industry in Sweden, are start-up entrepreneurs who are passionate about mitigating the climate and environmental issues, which is mainly about finding a better source of alternative protein for human in the insect for food company, and focus on decreasing the problem regarding food waste or organic material management in insect for feed companies. These motivations contribute to solving the environmental problem and creating economic benefits, plus the main goal of this entrepreneur in the previous study is to create sustainable development and earn money through corporate activities leading to "ecopreneurship" from the definition by Schaltegger and Wagner (2011). Considering the external aspect, regulation, and customer perspective are the main barriers in this industry, but they have been mitigated recently. For example, the permission to sell insects as food in Sweden and the opportunity of the growing demand for sustainable food from the customer side.

The business models represented by each company could be categorized as the sustainable business model archetype of Bocken et al. (2014) as a combination of two archetypes, namely 'create value from waste' and 'substitute with renewables and natural processes'. The study by Bocken et al. does not say whether it is possible to build a business model on two archetypes,
but it is obvious that the insect business in Sweden is building its business model to deal with waste management and the production of alternative protein. On the other hand, I have found that in an incumbent firm, the entrepreneur's motivation is different. The reason for starting the business is mainly because the current way of operating does not provide the highest value. They have thought of a new opportunity that will sustain the business in the long term and the motivation is based on the activities of the company.

As I can see, entrepreneurs in the insect industry in Sweden have a similar vision of changing the world as their motivation, which they are mainly influenced by hard structures such as a changing society, climate change, and insufficient future resources. I focus mainly on the point at which they started the business and how they see their business in the future, and whether they see it as a future economic opportunity or a sustainable opportunity. On the other hand, an R&D department in an incumbent firm is more influenced by soft structure influence such as the company’s activities rather than the motivation to change society. The business model of this type of ecopreneur tends to focus on the most valuable actions at any given time and change as they find new solutions that are more beneficial to the business. Of course, the negative environmental impacts must be kept to a minimum. However, I am not focusing on the incumbent in this research, but on start-ups. Therefore, it may not be possible to summarize the business model of the incumbent in this research.

*Firm-level barriers*

IPIFF (2019) identified three main challenges for the insect-based food industry today: scaling up, meeting consumer expectations, and regulatory challenges, which are similar to my findings. In this research, I identified the barriers into 3 groups: customer barriers, regulatory barriers, and financial barriers. The first barrier I found in the insect industry is finding a niche customer and a niche product to meet the expectation of that niche group of customers. It is not just only the customer acceptance or disgusting feeling but is more about finding the solution to these customer-based issues. I found that companies have invented solutions to overcome this barrier. In this research, most companies tend to produce processed products such as insect powder, protein bars, crispbread, and minced meat, which support the finding of Hartmann et al. (2015) and Reverberi (2021). Some companies emphasize that the image of insects as food needs to be developed.

“...media is one of the biggest problems we had so far because they're always selling on the yucky factor. So, it's always a person with an insect on the way into the mouth, you know... but I think if we start with the sport... it will open up [the acceptance].” [Interviewee no.2]

While some agree that we need to normalize insects as part of the food market, some think that it is better to market the healthy aspect of insects and perhaps start marketing to a niche group of customers. Therefore, the biggest barrier to customer-based issues from the firm-level perspective is not the customers themselves but the way that insect-as-food products are represented. It is seen that the innovative solution by the companies to find the niche product that fits their niche customer will possibly drive the industry to a better position where genuine
customer acceptance is open to them, not just the feeling that wants to try new things, but the feeling that wants to continue buying. And the last customer-based barrier is the price of the insect products which is expensive compared to other protein-based products.

On the other hand, the customer-based issues found in the insect-as-feed company are different from the insect-as-food company. For example, Company A faced that some customers were not ready to try this innovative fish feed or were not willing to risk it as it is a novel product. So, it is not because of the disgustingness or negative feelings from consumers because this is for being fed to the animal, not to humans. Compared to company E who joined the industry for quite a long time did not have the problem that the buyers were not willing to try. It might be a reason that most of the customers that company E had, were the customers from the former owners and they had utilized insects as feed for a long period for zoo animals, and the new customers that company E had were using insects to feed exotic pets which normally eat insects. However, I do not know whether the previous owner of Company E was in a similar situation to Company A. This could be the case, as the company was founded in the 1980s when there were not many people in Sweden who were involved in insect farming. It might be better if the study could find more companies producing insects for animals which involved in a similar time. Lastly, company J is an R&D department that has not faced the customer-based problem like the others, since they are at the demonstration stage.

The second firm-level barrier is the regulatory barrier. Although the regulatory barrier may not be the highest barrier blocking the movement of insect entrepreneurs today as it was in the past, such as the regulation that does not allow to sell insects for food. There were several entrepreneurs who left the industry and moved into other fields. However, the paths I learned from those who are still working and those who have left told me that they helped each other to overcome the barrier by creating a community, to negotiate with the government sector. Even if it was not successful, it was a good lesson. Today, the organization is revived by the old group of actors who still exist in this industry, together with new actors who have just started. The reason why I consider the regulation as a barrier at the company level is that different companies took different paths and activities to overcome this situation. Some shifted to focus on other products such as R&D of insect food and frass (Company C), some paused and focused on research and development, and trials (Company D), while some waited for the regulation to be approved and then started later (Company F). Moreover, the regulation that does not allow feeding insects with waste is still also another barrier in this industry which affect both insects-as-food and insects-as-feed companies.

Finally, I can see that finance is a massive problem for most start-ups. Some said that if you want to start small-scale production, having an automatic or robotic system is impossible. It is better to hire human labor, which is also expensive in Sweden. It is a dilemma, they agree that it might be better to use robotics if you want to scale up production, but it is expensive. So, it is like a race against time, cash flow, and finding a niche product and customer. But not everyone starts by building a farm, some start by buying insects from the supplier and making an innovative product. On top of that, I agree that good cash flow management is the most important business skill to start a business in this uncertain market.
In order to answer the first research question, ‘How have the business models been shaped over time and in relation to the opportunities and barriers perceived by the entrepreneurs’, I first identified the business model of each company and the barriers found along the companies’ path. The chronological timeline of the companies and events that affected the Swedish edible insect industry is shown in Figure 5. I could see from the business model that the value proposition and value creation & delivery are not much different in all companies. They mostly put the position of the business as alternative sustainable food and feed, create the value of circular economy and create the normalization of customer behavior in insect-eating. And one thing that is able to see when changes in barriers and opportunities in the business model are the companies’ value capture. From these value captures, I could divide the companies into three groups: quit companies, existing companies, and new entrants divided by the time that Sweden decided to join the transitional rules.

![Figure 5](image_url)

**Figure 5** The chronological timeline of the companies and the events that affected the Swedish insect industry. The companies’ lines show insect-as-food companies (grey), insect-as-feed companies (red), and insect breeder (green) (own figure)

First, there were 5 entrepreneurs who decided to leave the industry due to the regulatory issue and financial insufficiency, Company A, Company D (first phase), Company E, Company G, and Company H. The value capture in the business model of these companies was similar in that most of them were able to make the revenue through some sales, but it was insufficient to continue. For example, Company A was about to make a deal with the fish farm and pet food producer, but they needed more financial support to increase their production. Company D in the first phase also tried hard to earn more money, but as the scheme was not supported, there were not many actors or suppliers in the market. Instead, they had to sell in Denmark or order...
from abroad. In this group, Company A and Company G could not manage to create revenue due to the mentioned issues, Company D (first phase), Company E, and Company H managed to gain some revenues, but it was not enough to run and scale up the business.

On the other hand, the companies that started during the period when it was not allowed to sell insects as food in Sweden, but still exist today, are Company B, Company C, Company I, and Company J. Company B decided to set up production in Thailand instead and was able to sell the product worldwide, with a special focus on Thailand. They are also a supplier, providing insect powder to other companies. Similarly, Company C innovated to generate revenue from other products that could be sold, such as natural fertilizer from insect manure. They focused on R&D and have now become the largest supplier of mealworms in Sweden. In this way, both companies have been able to continue to generate some income and find investors or partners to help them survive. The company I is a breeder that was not directly affected by the regulation, so its business model has not changed much. Company J, on the other hand, has focused on the R&D phase and is an incumbent with revenues from other channels, so it has not been affected much either.

Finally, Company D (second phase) and Company F will be good comparisons with other companies business models, as the company has just entered the market, and it is now a moment that is quite open in Sweden. In addition, the company has received some support in the form of help and recommendation from the previous company in the industry. However, the company has not yet launched the product but is planning to do it this year. I could not wait and see the value captured in the business model in the near future.

4.2.2 TIS in focus on the insect in the Swedish food industry

The current consumption of traditional meat has several negative environmental impacts, such as greenhouse gas emissions, land use, and energy consumption. It is sometimes considered from the perspective of the ethical aspect of farming these traditional protein sources. There are discussions about whether we should switch to other alternative protein sources, such as plant-based projects and insect protein, as shown in this research. Such a transition could result in a reduction of environmental problems or the promotion of a cleaner environment. Therefore, the TIS in the focus of this study is the transition of insects as human food in Sweden. As I have already done the narrative analysis in the previous section and analyzed the functions of TIS in the following text in this section, I have found that the functions in the TIS that are importantly fit to this case study are 'entrepreneurial activities/experimentation', 'market formation', 'legitimacy creation', and ‘resource mobilization’.

The TIS structural components

Actors: The actors in this research are defined as companies that operate and used to operate insects for human consumption in Sweden. I was able to interview 7 companies and one journalist out of 9 interviewees. This is because the other interviewees do not focus on insects
for food production, but rather on insects for animal feed. Therefore, the actors in this study TIS are Company B, Company C, Company D, Company F, Company G, Company H, and Company I. These companies are involved in various aspects of the insect industry, from breeding and farming insects to developing insect-based products for human consumption. Another actor is a technical journalist who plays an important role in promoting the Swedish edible insect industry.

**Network:** The networks in this TIS are the relationships and collaborations between these companies and other stakeholders in the industry. These networks can be formal, such as partnerships or collaborations, or informal, such as knowledge sharing or joint participation in industry events. These networks facilitate the exchange of information and resources, which can accelerate the development and diffusion of innovations in the insect industry.

**Institution:** The main institution in this TIS is the Swedish Food Agency, which regulates the insect industry in Sweden. The agency's regulations, particularly the past regulation that did not allow the sale of insects as food, have significantly influenced the development of the insect industry in Sweden.

**The TIS functions**

*Entrepreneurial Activities/ Experimentation*
This function is about the efforts of entrepreneurs to turn potential opportunities into actual innovations. In the context of the Swedish insect industry, I see a lot of entrepreneurial activity. For example, Company I, a breeder of house crickets, supplies genetically improved crickets to insect farms or insect-based food and feed companies, which shows a unique entrepreneurial approach. However, barriers to these activities include regulatory restrictions, high start-up costs, and societal attitudes towards insects as food, as analyzed earlier in the analysis of barriers at the firm level. Entrepreneurial activities in this TIS include the various initiatives undertaken by companies to develop and commercialize innovations in the insect industry. These activities include experimenting with different insect species and feed formulations, developing new insect-based products, and exploring new markets for these products. Despite regulatory challenges, these companies have demonstrated a high level of entrepreneurial activity that has driven the development of the insect industry in Sweden. As I can see from each company's sustainable business model, their main goal is to get the insect product on the shelf in Sweden and for people to buy it as normal food, and that will help boost environmentally friendly activities e.g., waste reduction, and less carbon footprint in protein production to the world.

*Market formation*
This function involves creating a market for the new innovation. In the Swedish insect industry, market creation is still in its early stages, and was hindered by regulatory restrictions and social attitudes toward insects as food. Those mentioned blocks brought about an extemporaneous market, which shown as fewer suppliers of both insect supplies and on-shelf equipment in the very
early market. But companies have worked to overcome these challenges by positioning their products as sustainable and nutritious alternatives to traditional protein sources and by targeting niche markets such as health-conscious consumers and early adopters. On the other hand, the growing demand for sustainable protein sources and recent regulatory changes allowing the sale of insects as food in Sweden is driving market formation.

Creating Legitimacy
Creating legitimacy in this TIS involves efforts to gain social acceptance and regulatory approval for insect-based products. Companies have been working to create legitimacy by engaging with regulators as some mentioned creating the community, especially the keyword ‘lobbying’ in the interview and educating consumers about the benefits of insect-based products through marketing activities such as Facebook posts and joining fairs. And to gain more customer acceptance some companies tried to put their brand differently from others, for instance, putting it in a premium position and designing the packaging with high-quality materials and tones of color that represent premium. Nevertheless, the recent approval of insects as food by the Swedish Food Agency is a significant milestone in this process, indicating that the insect industry is gaining legitimacy in Sweden.

Resource Mobilization
This function involves mobilizing financial, human, and material resources for the development and diffusion of new innovations. In the insect industry, this can include investing in new insect-rearing technologies, hiring skilled workers, and sourcing organic waste to feed insects. For example, many companies are looking for more funding to expand production and increase output. In this early market in Sweden, some institutes or research centers have competitions and funding that companies can apply for, but as it is at a very early stage, not many investors are interested. One example is the shortage of insects in the beginning, when many companies had to order and import from abroad, and also the feed for insects, which is still expensive because there is less choice, and the regulation does not support feeding insects by subsidizing other industries or food waste. So, these issues lead us back to consider again the function of creating legitimacy. However, the entrepreneurs believe that the market is getting more attention, so in the future, there will be more interest from more investors and more funding, which will lead to more supply and a more stable market.

Policymakers could support these functions by providing funding for start-ups, promoting research and development in the insect industry, and launching public education campaigns to change societal attitudes towards insects as food.

Knowledge Diffusion
The sharing of this knowledge through collaborations and networks has been seen obviously throughout many interviews. For example, Company I is a house cricket breeder that provides genetically improved-house crickets to insect farms or insect-based food and feed companies. They also provide lab analysis for insect farmers or food producers who want to examine their insects’ quality. Moreover, some companies also help new entrant companies to build up the
insect farm by sharing their knowledge and experience. These are clear examples of knowledge development and diffusion in the insect industry.

**Knowledge Development**

In the case of the insect industry, this can include research into new methods of insect farming and the development of new insect-based products. As it is considered an uncertain market, knowledge is mostly developed through self-testing and experimentation and studied from open sources such as blogs, books, and YouTube videos. The knowledge is moving from the East to the West, from Asia to Europe, as insect farming and eating have been done in the East for a long time. And from the other countries in Europe where the regulation is approved and allowed to sell insects as human food before Sweden.

**Guidance of Search**

This function refers to the factors that influence the direction of innovation and development in the system. In the insect industry, since it is still in the early stage, there is no clear example of guidance provided for the actors to follow, but there are some studies about customer acceptance and product design research that the companies can take into account to follow. Moreover, in this study, I asked the entrepreneurs for their suggestions and tips to the newcomers, in order to build up the initial guidance of search for the industry in the future.

Each of these functions plays a crucial role in the development and growth of the insect industry in Sweden, and they are all interrelated. It is necessary to analyze the blocking mechanisms and inducements of the system from those functions and then provide guidance on how to move the market forward and successfully.

**Blocking Mechanisms**

In the previous section, I analyzed the barriers from the perspective of the firm level, which consists of 3 components: regulation, finance, and customer acceptance. It can also be seen here at the system level that these 3 components have a strong influence from the firm level to the system level, but there is another exceptional block that can only be found at the system level, which is 'uncertainty of the market', which can also be called a combination of these barriers and the different approach of each company to achieve the main goal. In the following text, I elaborate more on the last aspect of having diverse strategies as one of the system-level barriers, since the other components had been developed in the previous section.

The important aspect I have found is that companies are approaching the destination from different perspectives. The goal of this ecosystem is to put a product on the market that people will buy sustainably, not just the feeling of trying new things. The different perspectives could be seen through the focus of the entrepreneurs for example, some focus on finding the best recipe with both taste part and economic part, some focus on finding the niche customer groups, some focus on the image of the product to open the acceptance of the customer, and some focus on making insect eating normalized in the society. It might be good if all entrepreneurs could combine all those perspectives or strategies and promote them in the same direction.
Inducements

The system-level drivers I found consist of 4 drivers: growing societal demand for sustainability, sustainable business activities, networking and collaboration, and regulatory change or institutional support. First, the growing demand for sustainable and alternative protein sources, such as insects, which require fewer resources to farm than traditional livestock and offer a viable and environmentally friendly solution. This sustainability aspect is complemented by the second driver, which is a surge in innovation and entrepreneurship within the industry. Companies are continually developing and commercializing new insect-based products, demonstrating a high level of entrepreneurial activity that is driving the industry forward. Thirdly, ecosystem collaboration, such as knowledge sharing and collaborative relationships, such as creating a community and meeting to support each other, will reduce market uncertainty in this early-stage market. Finally, regulatory changes to support entrepreneurial activity will accelerate the market and open up new opportunities for both incumbents and new entrants.

The implications of policies

From the analysis of the barriers and inducements in this study, I have been able to build up some policy implications that could possibly help to dissipate the power of the barriers and at the same time be driven by the inducements in the system. Figure 6 shows the relationship between each box of barriers and incentives that influence and are influenced by the policy implications. Firstly, the policy should provide clarity of the regulation so that the entrepreneurs could follow those regulations or guidelines, for example, the entrepreneur will know whether the leftover food or waste could be fed to insects to reduce the amount of waste and produce high-quality protein from insects. And this policy can reduce the regulatory issues and market uncertainties that block the system, and at the same time, the policy could be guided by the demand for sustainability from society, business activities (lobbying), and the network and cooperation within the ecosystem or incumbents. Secondly, institutional support such as research institutes will reduce the negative cash flow of companies and also help to accelerate the development of the ecosystem. This policy may happen after the increasing demand for sustainability from society and the change in regulation. Thirdly, customer education is an important policy to open up the acceptance and purchasing power from the customer side. Finally, the sustainability incentive should be provided to companies as a tax subsidy to support their activities to produce sustainable alternative products. However, there is a blocking mechanism that I have not linked to the policy implication because it is different from the others. It is a system-level blockage that is blocked by each entrepreneur, so to alleviate this blockage, each entrepreneur must share and set the rigid goal and the way to reach the goal similarly. This may be important at this early stage of the market, but the strategy of the
companies may change later when the market is more certain. Nevertheless, these policies are only the synthesis of this report. There may be more possible and stronger policies.

*Figure 6 The synthesis of the policy implications*
5 Discussion

This study contributes a deep understanding of the firm-level perspective through the case study of an uncertain market on how the different actors acted in different phases of business development, from the longitudinal case study of edible insects in Sweden. Moreover, in my study, the findings and analysis contribute to all the categories divided by Muñoz and Cohen (2017). First, in the actor or sustainable entrepreneur category, I put deep attention to the actor, so-called the firm-level. For example, I analyze the business model and found that the actors or companies which was established before the regulation was lifted but survive and still running the operation today are the companies who act as a supplier which have their farm and process the insects into powder which could be utilized in a variety of ways. Second, the category of context for sustainable entrepreneurship was analyzed in the narrative showing that the relationship in the Swedish edible insect industry is still in the niche and novel stage in which actors involved in the field are having collaborative relationships. Third, sustainable entrepreneurship outcomes are shown through the value creation of the companies, for instance. Lastly, the sustainable opportunities are seen through the opportunities that the entrepreneurs took, for instance, they selected to start the edible insects business because the insect is the future food which is more sustainable than the traditional meat.

In addition, this study also contributes new knowledge under one of the key functions in the TIS, the guidance of search. Since the focal case of the study is an uncertain market which means niche and novel, therefore, the guidance of search is not yet contributed much. In summary, this study provides an in-depth understanding of firm-level strategies, context, outcomes, and opportunities in sustainable entrepreneurship within the edible insect industry in Sweden. It also enhances our comprehension of the guidance of search function within the Technological Innovation System, particularly in uncertain markets.

5.1 Sustainable Entrepreneurship and sustainable business model

In discussing the dynamics of innovation systems, Bergek et al. (2008) point out that differences and disagreements are inherent and that entrepreneurs do not always need to work together towards the same goals. However, this study highlights the potential benefits of collaborative relationships in an uncertain market, especially when the industry ecosystem is relatively immature. Under such conditions, collaboration could be crucial in moving the innovation system forward.

The focus of this research shows that the majority of these entrepreneurs are united in their overarching goal: to establish insects as a sustainable alternative protein source and to create a viable market for their products. Despite this common goal, these findings show considerable diversity in the business models they have adopted. This variation is in line with the concept of ‘ecopreneurs’ - entrepreneurs who are motivated by ecological considerations and typically pursue environmentally friendly business models. In my study, I observed that the type of ecopreneur often reflects the activities, suggesting a strong interplay between personal
motivations and business models. It remains unclear which business model will ultimately prove most effective in the insect as an alternative protein industry. However, the common goal of these different business models suggests a kind of unspoken cooperation, even in the face of strategic differences.

Given these findings, future research could further investigate the role and impact of these different business models in emerging industries or the mechanisms by which different entrepreneurial motivations can align toward a common goal within a young industry ecosystem.

5.2 Barriers from the firm-level perspective in an uncertain market

One of the main findings of this research is the importance of identifying niche markets for insect-based products in Sweden. This extends the work of van Huis et al. (2021) and Reverberi (2021), which highlighted the general challenges insect start-ups face in identifying target groups and selling points. Moreover, in the finding of Niyonsaba et al. (2022) found that the highest barriers for insect-based food companies in European countries are regulatory barriers such as lack of safety data for submission of legal registration, and national legal restrictions concerning the use of insects in food, and insufficient the demand for insect-based products. However, this work adds a new dimension by focusing specifically on the Swedish context, which is characterized by a late entry into the edible insect industry compared to other European countries. This late entry presents unique challenges and opportunities for Swedish insect start-ups, which this research brings to the fore.

This study also contributes to a broader understanding of regulatory barriers in the insect-as-food and insect-as-feed industries. While the first regulatory approval for the sale of insects as food in Sweden in 2020 was a notable step forward, these findings highlight the ongoing complexity of this process. In particular, I shed light on the nuances of regulations regarding food waste that can be used as insect feed, a factor that can have a significant impact on the sustainability and profitability of this industry. This adds depth to the work of Huis and Oonincx (2017), who discussed the potential of insects to convert food waste into valuable protein. My exploration of specific industry practices, such as some companies' experimentation with by-products for insect feed and Company J's research into organic materials for their Black Soldier Fly feed, provide valuable case studies for other start-ups facing similar challenges. These insights can inform future research and development in the sector, providing tangible examples of innovative approaches to overcoming barriers and optimizing production.

Moreover, I also highlight the close relationship between regulatory and financial challenges faced by Swedish insect start-ups. These findings are consistent with the broader literature on start-up challenges. However, it provides a specific perspective in the context of this new industry in Sweden. As this study found, because the industry is still small, many companies import feed and insects from outside Sweden, which results in high costs. One of the main
financial burdens is the high cost of insect feed. This is mainly due to unsupported regulations about what can and cannot be fed to insects. This research is in line with previous studies that have demonstrated the unique ability of insects to convert waste products into valuable protein sources (Huis and Oonincx, 2017). This is hindering the industry's ability to develop systems and reduce costs. For example, one entrepreneur in this study had to comply with regulations designed for pigs, which are very different from those for insects. This highlights the urgent need to develop new regulatory controls in the insect industry. This is therefore an important topic for future policy work and research.

5.3 The Activities of Sustainable Entrepreneurs and TIS

This research on the Swedish insect-as-food industry sought to understand "How do entrepreneurial activities stemming from the business models drive the evolution of the Technological Innovation System in the Swedish insect-as-food industry?". Analysis of the seven key processes or functions within the Technological Innovation System (TIS) framework provided rich insights into this novel industry.

Entrepreneurs in the Swedish insect-as-food industry show a mix of economic and environmental motivations that drive their activities. These motivations are in line with the concept of ecopreneurship as proposed by Dean and McMullen (2007), where these entrepreneurs seek not only economic gain but also the solution to environmental problems. In addition, these entrepreneurs show considerable resilience and adaptability in overcoming regulatory and societal barriers to establish and grow their businesses in a challenging market. For example, Company A decided to locate their business in Thailand, Company C decided to work on research and sell other products such as animal feed while waiting for regulatory approval, and Company J waited to enter the market years later as it has become more open recently. At the same time, I could see that some entrepreneurs also left the industry because of the main barrier of regulation. These also tried to survive by 'lobbying', but it did not work, but it was an activity to show their ambition to fight a big challenge.

Moreover, ‘adaptability’ was discussed in the study by Daub and Gerhard (2022) who studied a Swiss edible insect company. They found that adaptability and flexibility were key to survival. But there was one thing different, it was the time that they passed the law to sell insects in Switzerland was much faster than in Sweden. That is why I think that adaptability and flexibility can only work in some cases, for example, if the company has enough money to run the business and hire people with no or insufficient income.

In discussing the evolution of TIS, the entrepreneurs’ activities have not only shaped the individual business approach but also began to shape the industry ecosystem, creating the foundation for an emerging market, and influencing regulatory change. I can see the evolution in some key functions as in the following examples. First, entrepreneurial experimentation function, as companies mentioned their situation as the forefront of the novel industry, Company A, for example, tried to rear the insects themselves with the knowledge from online.
Another example is Company H tried to develop a brand and package that looks luxurious to open up new acceptance from customers to insect products. Their efforts to harness and adapt new technologies are not only enriching their respective businesses but also catalyzing a wider evolution of this innovation. The second function is the market formation function. The companies have positioned their insect products as sustainable and high nutrition in order to create a niche market and create niche customer acceptance as Company B and Company D did their marketing to the gym person. Another notable contribution of these ecosystems to the development of the TIS is in line with their efforts to legitimize the regulation of selling insects as food, creating legitimacy. By working with the regulator and educating customers about the benefits of eating insects, they are now seeing the regulatory barrier to selling insects being overcome and increasing customer acceptance.

It is clear from their activities that entrepreneurs are not just participants or components in the TIS, but catalysts for the development of the industry. Although in the midst of the challenges, some entrepreneurs have pushed the boundaries of innovation and are working on it through strategies such as targeting niche consumers, lobbying for regulatory change, and sourcing for financial and material supplies. These entrepreneurs are steadily shaping a more favorable TIS for this emerging industry. This is consistent with Cohen and Winn's (2007) view of market imperfection which suggests that entrepreneurs are using the challenge to drive sustainable activities.
6 Conclusion
The research findings have the potential to significantly enrich the theoretical framework of sustainable entrepreneurship and sustainability transition studies. By incorporating a case study of an industry shrouded in uncertainty and by delving into firm-level analysis, this research sheds light on the nuanced factors that shape sustainability efforts in such industries. In addition, the research highlights the urgency and viability of exploring alternative protein sources, contributing to a global discourse on sustainable solutions to impending protein shortages. However, if the edible insect industry in Sweden is to flourish and effectively address protein scarcity, further research is essential. For example, research into the policy framework is crucial to understanding and overcoming the barriers that this nascent industry faces, both now and in the future. In addition, the research provides invaluable data through narratives of the edible insect business. These narratives serve as a source of information that researchers can use as a springboard for future studies. This can range from an in-depth analysis of the Swedish edible insect industry to broader investigations of market development in uncertain environments.

This research also has ethical and social implications. It promotes awareness of the need for sustainable food sources, which in turn could lead to a change in consumer attitudes and behavior towards alternative proteins such as edible insects. This is particularly important in societies where such options may not be considered conventional. On the policy front, this research could serve as an impetus for policymakers to engage in informed discussions and potentially formulate policies that are conducive to the growth and development of sustainable industries such as the edible insect sector. In summary, this research serves as a cornerstone of sustainable entrepreneurship and transition studies, paves the way for informed policy-making, promotes ethical and social awareness, and contributes to global sustainability efforts.

6.1 The finding of sustainable entrepreneurship and sustainable business model
Regarding the first research question, the motivation found in the Swedish insect start-ups is influenced by the hard structural influence, namely environmental change and global benefit. This is in line with the value proposition in the business model of most of the companies, which aim to produce a sustainable alternative protein source, while at the same time helping to mitigate environmental impacts, such as reducing food waste or converting organic material into more value.

Barriers from the firm-level perspective, I identified from each company's answer regarding the challenges they faced during each stage of the company’s development. I found that the main barrier that companies mentioned is the regulatory barrier. The company that aims to produce insects for the food section was facing a regulation that did not allow them to sell insects in Sweden, but they had started the business already during that time. I found that only some companies still operate the business, while most of them could not overcome that barrier, since the regulation was deciding for long.
The second barrier is finding customers. The previous study and some participants in this research also mentioned customer acceptance, but it is now wide open in this market. Customer acceptance mostly depends on the form of the insect products, and they prefer to buy the processed product. In the findings, I found that the companies are/have been producing products that cannot see the physical body of the insect, but rather are produced in the form of powder, crispbread, and protein bars for example. Customer acceptance seems to be less blocking the industry development than finding the niche customer or the real customer who will continue to buy the product and open for the insect product to be normalized in the market.

The final barrier is the financial barrier. Although the financial barrier seems to be a big barrier in many start-ups in any field, they seem to be bigger when it comes to the Swedish insect industry. The human wage in Sweden is high compared to many countries in the world, and it cost the majority of the operating cost of the company. Some said that Sweden better use robotic systems to mitigate this cost, but at the same time the market is still small, and the start-ups could not effort that huge amount of robotic investment.

6.2 The finding of the relationship between Sustainable Entrepreneurs and TIS
Entrepreneurial activities and motivations have strongly influenced individual business approaches and the TIS industry ecosystem. This has led to the creation of an emerging market and has had a significant impact on regulatory change. Entrepreneurial experimentation and market formation are key functions of the industry, as entrepreneurs seek to harness new technologies and legitimize the regulation of the sale of insects as food. However, the work of entrepreneurs goes beyond these functions. Entrepreneurs act as catalysts for the development of the industry, pushing the boundaries of innovation through a variety of strategies. For example, some entrepreneurs target niche consumers and develop unique products or services to meet their needs. Others lobby for regulatory change to create a more favorable environment for industry growth. In addition, entrepreneurs are constantly seeking financial and physical resources to support their businesses.

Taken together, these activities have helped to transform the TIS industry, making it more resilient and adaptable to change. Furthermore, entrepreneurial activities and motivations have enabled the TIS industry to create new employment opportunities and drive economic growth.

6.3 Future research
In terms of future research recommendations, it may first be helpful to understand the specific strategies that entrepreneurs use to overcome each barrier. Similarly, as the industry evolves and is expected to grow, the impact of the scaling process experienced by these start-ups should also be examined. For example, the potential for automation or robotics in the industry could be an attractive prospect for sustainable entrepreneurship in the Swedish insect industry. The dynamic nature of the field means that there is much more to be explored and understood. Secondly, as the aim of the research is to fill the gap of an in-depth study of the firm-level perspective in the study of sustainability transitions, I have only emphasized the actors 'start-ups'. Therefore, I suggest that it is necessary to study the actors such as customers, food
agencies, and researchers to provide a more in-depth firm-level or actor-level perspective on the sustainability transitions study. In addition, the study about the traditional protein farm that would like to shift to insects as a novel alternative protein is also interesting. Lastly, one of the findings that entrepreneurs now face is finding a niche group of customers, so it might be helpful for the industry if future research could help analyze the potential early adopters of insect-eating in Sweden and European countries.
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Appendix 1

*Interview Guide*

**Personal Background**
- Can you please introduce yourself?
- What is your name? Where are you from? What did you study? What are you doing for a living?

**Organizational aspects**
- How did you get into the insect business?
- Where are/ or were you in the insect industry? When did you establish the company? What are your products? Who is your customer? Is your company a B2B or B2C, or other?
- How many people are there in the company? How do you get the right supplier(s)/experts/employees? What are the criteria when you recruit people?

**Operational/ processing aspects**
- How many species of insects and what species of insects do you farm? What is the reason for choosing that insect species? Are there any risks and benefits of farming this/these insect(s)? Do you breed the insects in the company? Or do you have suppliers/experts for this? Who is the supplier?
- What type of feed did you use for feeding your insects? and what is the reason of using that feed?
- In the operation chain, which process creates the most waste? How does your company deal with those waste?

**Financial aspects**
- How did you earn the capital? Did you have any investors? Who and when? Or did you operate the company with your own money?
- Who was financially involved in your business? Who is/are the shareholder(s)?
- How was your production?

**Market/ Marketing / Consumer acceptance aspects**
- What is the most challenging of entering the market?
- In this supply chain, who do you think is the most important or key driver to enlarge the market? and how?
- In your opinion, is consumer acceptance still a barrier in the Swedish insect market? Does it change recently?
- Do/did you have any plans to scale up your production? What can be challenging and how do you prepare for them?
- How do you see the future of the insect industry in Sweden?
Institution/ regulation

- How does/did your company plan to collaborate with other organizations in the insect-based food industry?
- How does/did your company plan to collaborate with external organizations in the insect-based food industry?
- In 2015, the EU Commission approved selling some insect species as food for humans, but the Swedish food agency had a wrong interpretation and did not allow any Swedish company to market insects as food for humans. After that in 2020, the Swedish food agency announced that some species of insect according to the EU Commission can be sold as human food.
- What did your company do in those 5 years? How did that affect your business strategy and plan?

Sustainable entrepreneurial and ethical aspects

- “Insect is a sustainable alternative protein”, how do you think about this?
- Do you consider yourself a sustainable entrepreneur?
- What do you think is/are the barrier to being a sustainable entrepreneur in this insect industry?
- How do you ensure your insect welfare? Cleanliness, safety, sufficient and good feed?

Other

- Do you have anything to say or suggestions for the new entrants? Would you do something differently if you can back in time?
### Appendix 2

#### Coding

<table>
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<th>Concept</th>
<th>Theme</th>
<th>Coding</th>
<th>Description</th>
<th>Example</th>
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| Sustainable Business Model    | Value proposition            | Environmental Problems | When the company mentioned the problem, they wanted to solve. I analyze the solutions that the companies provided or how the company wants their products to be seen by the customers.                                | • Lacking protein in the future  
• Food waste  
• Looking for an environmentally friendly protein source  
• Overfishing                                                                                                 |
| Company problem               |                              | The company was looking for the solution that create the highest the value or better benefit for the company, but also thinking about the environment.                               | • Organic material management                                           |
| Product positioning           |                              | The description of the product(s) that the company had/ have/ or planning to have.                                                                            | • Premium product  
• Normalize the diet behavior.  
• High protein product                                                                                         |
| Product type                  |                              | The type of the product                                                                                                                                          | • Flour  
• Crispbread  
• Minced meat                                                                                               |
| Product purpose               |                              | The propose of the product                                                                                                                                 | • For human food  
• For livestock animal feed e.g., fish feed  
• For pet, exotic pet, zoo animal                                                                             |
| Value creation & delivery     | Resource creation            | The resource that the company created from their activities or products                                                                                       | • Knowledge creation  
• Research experimentation  
• Insect protein as environmentally friendly alternative protein  
• Circular Economy  
• Innovative product recipe creation  
• Innovative insect feed creation                                                                                   |
| Delivery/ Distribution channel|                              | Distribution channel that the company delivery their product                                                                                                  | • B2B  
• B2C  
• Web shop                                                                                                      |
| Partner & relationship creation|                              | Business partners or the relationship with the stakeholders                                                                                                     | • Brand co-creation with other industries                                                                                   |
| Value capture                 | Revenue stream               | The income or benefit that the company creates                                                                                                                  | • Sales  
• Salary  
• Investment                                                                                                      |
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<tr>
<th>Barriers &amp; Opportunities</th>
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<td>The regulatory that the companies mentioned as their barriers</td>
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<td>Cost structure</td>
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<td>Cost reduction from the feed recipe</td>
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<td>The regulation to sell insects as food.</td>
<td>Finding the niche group of customers</td>
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