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Navigating the business model design space: A case of insects as food and feed in Sweden

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ABSTRACT

Business model innovation (BMI) plays a key role in driving sustainability transitions, yet its interplay with the broader socio-technical system is often overlooked. This study investigates BMI in the emerging niche of insect-based food and feed in Sweden, employing a combined Business Model Design Space (BMDS) and dynamic capabilities perspective. Drawing on interviews with ten insect firms, we examine how firm-level dynamic capabilities shape BMI strategies and interact with the BMDS. Our findings show that firms adopt different strategies to navigate the opportunities and constraints they perceive within the BMDS. We introduce a novel typology that outlines how firms perceive and respond to the BMDS through two dimensions: BMDS Sensing (systematic & intuitive) and BMDS Enactment (fit-and-conform & stretch-and-transform). This typology identifies four distinct BMI seizing modes: Analytical Adaptation, Analytical Shaping, Instinctive Adaptation, and Instinctive Shaping, highlighting how firms interpret and enact the BMDS through BMI. By integrating dynamic capabilities theory with the BMDS framework, we address the gap of accounting for varied perceptions of the BMDS among different actors. We show how firms exercise strategic agency in shaping and responding to system-level dynamics, offering new theoretical insights that bridge firm-level and system-level perspectives on BMI within emerging niches.

1. Introduction

An increasing global population is driving an unprecedented rise in the demand for animal protein, a trend that poses substantial challenges such as biodiversity loss and environmental degradation (Aiking and de Boer, 2020; Kumar et al., 2023; Willett et al., 2019). In response, the exploration and development of alternative protein sources, including insect-based options, are gaining prominence (Madau et al., 2020; Mylan et al., 2019; Tziva et al., 2020). Protein derived from insects presents numerous environmental advantages, requiring minimal use of land, pesticides, and water, as well as embodying high efficiencies in converting feed to food and with minimal greenhouse gas emissions (Hadi and Brightwell, 2021; Jansson et al., 2019; Madau et al., 2020; van Huis et al., 2013). Additionally, the ability to valorize industrial waste streams as feed suggests that insects could play a role in meeting growing protein demand more sustainably (Borrello et al., 2016).

Yet, while the environmental and sustainability potential of insect-based protein is increasingly well documented, translating these benefits into scalable and commercially viable solutions poses significant challenges. Despite the historical consumption of insects by approximately 2 billion people worldwide, the industry remains nascent, with the intensive rearing of insects for food and feed in its infancy (Berggren, and A., and Low, M., 2018; van Huis, 2020; van Huis et al., 2013). Broad market acceptance faces considerable challenges, notably consumer acceptance, which is a significant barrier, particularly in Western cultures where dietary norms do not traditionally include insects (Kellert, 1993; La Barbera et al., 2018). Additional challenges include navigating emerging regulatory frameworks and developing efficient production and distribution systems that can compete with established sources of protein (Siddiqui et al., 2023). These challenges highlight the disconnect between the potential of insect-based protein and its current nascent status.

Business models play a central role in addressing these challenges, supporting the operational success of insect firms and their value

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propositions (Bidmon and Knab, 2018; Broccardo et al., 2023; Casadesus-Masanell and Ricart, 2010; Chesbrough and Rosenbloom, 2002; Lüdeke-Freund, 2020; Margretta, 2002; Schaltegger et al., 2016a). Business model innovation (BMI), which encompasses the design or redesign of a company's approach to doing business, is key to bringing new value propositions to market that often require new ways of creating, capturing, and delivering value (Bocken and Short, 2016; Chesbrough, 2007; Sarasini and Linder, 2018; Schaltegger et al., 2016a). However, effective BMI requires strategic alignment with the broader socio-technical context, an aspect that is often under-represented in BMI literature and practice, which tend to adopt a predominantly internal firm focus (Bolton and Hannon, 2016; Boons and Lüdeke-Freund, 2013).

To bridge this gap, the concept of the business model design space (BMDS) has been introduced. This analytical framework facilitates the examination of the interplay between firm-level BMI and the broader socio-technical system (Huijben et al., 2016; Wesseling et al., 2020). The BMDS highlights both the opportunities and limitations involved in developing viable business models within a specific socio-technical context (Wesseling et al., 2020). It is bounded by the dimensions of *science and technology*, *culture*, *markets*, *policy*, and *industry*, which together elucidate the socio-technical space that firms must navigate during BMI (Wesseling et al., 2020). Yet, despite its utility as a firm-level transitions framework, a key limitation of the BMDS is its lack of focus on firm-level agency in determining the choice of BMIs. Wesseling et al. (2020) argues that the framework, while effective in mapping the connection between the business model and the socio-technical system, does not adequately account for the factors that shape how firms identify and interpret opportunities within the BMDS. This understanding is essential for elucidating why firms choose specific BMI pathways. For instance, an innovative startup experienced in launching novel food products might perceive the BMDS boundary of culture differently from a traditional food industry player newly venturing into the emerging niche of insect-based food and feed. We argue that the differing capabilities of firms to perceive and respond to the BMDS will influence the way in which the business model is innovated. Strengthening the agency focus of the BMDS framework, therefore, has the potential to not only answer how different BMI approaches relate to the BMDS but also enhance our understanding of why firms pursue particular BMIs in the first place.

To address this gap, our study aims to enrich the BMDS framework by integrating insights from the strategic management literature on dynamic capabilities. Dynamic capabilities, including the activities of sensing, seizing, and transforming, account for firm-level agency in identifying and responding to new business opportunities in uncertain environments (Haarhaus and Liening, 2020; Teece, 2007), and are considered important drivers stimulating the business model innovation of start-ups (Oliveira-Dias et al., 2022). This addresses a limitation of the BMDS framework, which implicitly assumes that its boundaries are understood and interpreted in the same way by all actors. By combining the tripartite actions of sensing, seizing, and transforming from dynamic capabilities with the BMDS framework, we seek to more comprehensively account for firm-level agency within broader sustainability transitions. This approach allows us to explore how firms in the emerging niche of insect-based food and feed perceive BMDS opportunities (sensing), innovate their business models to capitalize on these opportunities (seizing) and, in turn, influence the BMDS itself (transforming).

Our research questions focus on how these firms engage with the BMDS – specifically, how do insect firms sense the available opportunities within the BMDS, and how do they innovate their business models to seize these opportunities and transform the BMDS? To answer these questions, we build on in-depth interviews with entopreneurs (insects-as-food-and-feed entrepreneurs) in Sweden. The context of Sweden, characterized by a growing recognition of the need for a 'protein transition', an emerging legislative framework for insects as food and feed, alongside significant cultural resistance to insect consumption, presents a fruitful setting to investigate firm- and system-level BMDS dynamics.

In the analysis of the empirical material, we identify two principal means by which firms sense the opportunities within the BMDS: systematically and intuitively. Our findings indicate that the manner in which a firm senses the BMDS shapes how they subsequently innovate their business models to seize these opportunities, either by fitting and conforming or stretching and transforming the BMDS. We propose four seizing modes that describe how firms navigate the BMDS. By integrating dynamic capabilities into the BMDS framework, our research offers new theoretical insights that bridge firm-level and system-level perspectives on BMI in emerging niches. Consequently, our findings enhance the understanding of BMI in emerging niches, particularly emphasizing the bi-directional influence of BMI on the BMDS. Thus, we contribute to a growing body of work exploring a firm-level view of sustainability transitions (Boons and Lüdeke-Freund, 2013; Magnusson and Werner, 2023; Sarasini and Linder, 2018; Werner et al., 2022). Additionally, this research provides insights into the emerging niche of insect-based food and feed in Sweden.

2. Theoretical background

2.1. Sustainable business model innovation in emerging niches

Technology, in itself, lacks intrinsic value (Chesbrough, 2007); it is through its interplay with a business model that its latent potential is realized (Björkdahl, 2009; Zott et al., 2011). A business model, although diversely defined, essentially outlines how a firm operates through a system of interdependent activities (Casadesus-Masanell and Ricart, 2010; Margretta, 2002; Teece, 2010; Zott and Amit, 2010). Despite the absence of a universally accepted definition (Wirtz et al., 2016), business models are often conceptualized as describing the "design or architecture of the value creation, delivery, and capture mechanisms" of a firm (Teece, 2010, p. 191). Value creation refers to the positive acknowledgement of a value proposition by a particular target group and the benefits that group perceives as a result (Zott and Amit, 2010). The methods and strategies employed to effectively connect with the target group via sales activities constitute value delivery (Zott and Amit, 2010). Additionally, value capture relates to the process of securing value for the focal organization in terms of revenues and profits (Teece, 2010). While these value functions form the core of conventional business models, emerging challenges and opportunities, particularly in sustainability contexts, demand additional value dimensions (Lüdeke-Freund et al., 2024). In emerging niches such as insects as food and feed, firms are not only focused with creating value for themselves but also on addressing pressing environmental and social issues (Lüdeke-Freund and Dembek, 2017; Schaltegger et al., 2016b; Stubbs and Cocklin, 2008).

Reflecting these broader objectives, the concept of a Business Model for Sustainability (BMfS) has emerged, introducing three additional value functions. A BMfS has been conceptualized as referring "to how an organization proposes, delivers, captures, maintains, unlocks, and shares value with and for its stakeholders" (Lüdeke-Freund et al., 2024, p. 209). Maintaining value refers to preserving ecosystems and resources while sustaining the functionality of man-made materials and infrastructures. Unlocking value refers to utilizing untapped potential for sustainable value creation by engaging customers and markets. Sharing value refers to engaging stakeholders to ensure fairer distribution of benefits and opportunities for skill development and growth (Lüdeke-Freund et al., 2024). These value functions are supported by sustainability specific design themes that mediate business model activities and sustainable value creation (Lüdeke-Freund et al., 2024). These are complementary to the design themes of novelty, lock-in, complementarities, and efficiency, which characterize the conventional value functions of proposing, delivering, and capturing value (Amit and Zott, 2015; Zott and Amit, 2010). A summary of BMfS value functions and their associated design themes is presented in Table 1.

Similar to conventional conceptualizations, BMfS are a static

Table 1
BMfS Value Functions and Design Themes (adapted from Lüdeke-Freund et al., 2024).

Value Function	Value Function Description	Design Themes
Proposing Value	Offering a potential benefit to a target group to address customer needs	*Novelty *Lock-in *Complementarities *Efficiency
Delivering Value	Connecting to a target group e.g. via sales activities – how the company fulfills the promise to the customers	*Novelty *Lock-in *Complementarities *Efficiency
Capturing Value	Creating a benefit for the focal organization in terms of revenues and profits	*Novelty *Lock-in *Complementarities *Efficiency
Maintaining Value	Preserving ecosystems and resources while sustaining the functionality of man-made materials and infrastructures	*Avoiding harmful substances *Avoiding waste *Extending life cycles *Reducing resource consumption
Unlocking Value	Utilizing untapped potential for sustainable value creation by engaging customers and markets	*Facilitating informed decision-making *Influencing purchasing behaviour *Influencing user behaviour *Making sustainable offerings accessible *Stimulating demand for sustainable offerings
Sharing Value	Engaging stakeholders to ensure fairer distribution of benefits and opportunities for skill development and growth	*Improving stakeholders' socioeconomic conditions *Offering access/ opportunity *Supporting environmental/social causes

representation of how a firm operates. Building on this static view, business models have been conceptualized as both "a vehicle *for* innovation as well as a subject *of* innovation" (Zott et al., 2011, p. 1034). In this context, BMI becomes pivotal. BMI has been defined as the "designed, novel, and nontrivial changes to the key elements of a firm's BM and/or architecture linking these elements" (Foss and Saebi, 2016, p. 216). This concept is particularly relevant when considering technologies with sustainability potential. For instance, using insects for food and feed can yield different sustainability outcomes based on the business model applied and the value that is captured (Broccardo et al., 2023). In other words, the ways in which firm activities contribute to sustainable business model design themes influences the potential value that can be created (Lüdeke-Freund et al., 2024). A case in point is the production of insects from valorized waste streams that unlocks value from untapped potential, as opposed to relying on manufactured inputs. This indicates how sustainability and market outcomes are contingent on the business model when the underlying value proposition remains the same (Sarasini and Linder, 2018). Therefore, examining business model innovation alongside technological advancements is crucial for a comprehensive understanding of the sustainability of firms' business models and how they organize themselves in emerging niches.

Niches function as protected spaces where entrepreneurial activities are shielded from mainstream selection environments (Kemp et al., 1998). This supports not only the development of novel technologies but also the business models that realize their potential (Huijben et al., 2016). Prior work on business model innovation anchored in niches has explored areas such as mobility services (Meijer et al., 2019; Sarasini and Linder, 2018) and solar photovoltaics (Huijben et al., 2016). These niches often benefit from structured government support, offering established avenues for innovation. For example, the commercialization and scaling of solar photovoltaic technologies within applications for space and telecommunications were reliant upon governmental R&D support to materialize (Huijben et al., 2016). However, the agri-food sector, especially in the context of using insects as food and feed, is an emerging niche lacking similar levels of institutional support and buy-in.

A key feature of emerging niches, such as insects for food and feed in Sweden, is that firms are continuously experimenting with new technology and business model combinations for both a current and future desired socio-technical system. Indeed, prior studies show that business models are not only a depiction of a firm's current way of doing business but also a projection of future anticipated change (Doganova and Eyquem-Renault, 2009; Huijben et al., 2016). Business model innovation is, therefore, viewed as one of the key processes that can help firms exit niches through alignment with the prevailing socio-technical regime – the rules, practices, technologies, and norms within a particular domain (Bidmon and Knab, 2018; Geels, 2004; Sarasini and Linder, 2018). Despite this, the specific strategies niche firms employ to integrate with and influence the wider socio-technical system remain underexplored (Boons and Lüdeke-Freund, 2013). In this context, the BMDS presents a promising approach for bridging a firm- and systems-level perspective.

2.2. The business model design space

Developed as an analytical framework to deepen understanding of transition dynamics, the BMDS connects firm-level activities with broader system-level dynamics (Wesseling et al., 2020). Defined as encompassing "the opportunities and constraints to design novel ways of creating and capturing value from niche technologies available at a given point in time in a transition" (Wesseling et al., 2020, p. 1), the BMDS effectively outlines the range of potential BMIs accessible to firms within a specific socio-technical context. It therefore encompasses the business opportunities and constraints that niche entrepreneurs must navigate when innovating business models (Huijben et al., 2016; Wesseling et al., 2020). The core value of the BMDS lies in its capacity to explain the reciprocal relationship between firms and the wider socio-technical system through the intermediary role of business models (Bidmon and Knab, 2018; Bolton and Hannon, 2016; Sarasini and Linder, 2018). On one hand, firm-level BMI influences broader transition dynamics through new value creation that can potentially alter market structures, consumer behaviors, and industry practices (Boons and Lüdeke-Freund, 2013; Schaltegger et al., 2016a). On the other hand, system-level changes such as technological advancements, regulatory changes or cultural shifts, simultaneously shape how firms innovate their business models (Lüdeke-Freund, 2020; Meijer et al., 2019).

Initially, the BMDS framework centered on policy perspectives (Huijben et al., 2016), but it has since expanded to include five key socio-technical system dimensions: *science and technology*, *industry*, *culture*, *market*, and *policy*. These dimensions are crucial in showing both the opportunities and constraints that firms face when pursuing BMIs, shaping the "art of the possible" in business model innovation (Wesseling et al., 2020, p. 7). Building on Geels (2004) socio-technical system dimensions, and the work of Wesseling et al. (2020) and Huijben et al. (2016) on the BMDS, the *science and technology* dimension pertains to the accessibility of technology and knowledge essential for innovating and capturing new value across the value chain. This dimension covers not only the availability of relevant technologies but also the access to the required skills and expertise to effectively implement them. The *industry* dimension focuses on the presence and readiness of industry participants to either collaborate or compete within the supply chain. It also encompasses the established norms and practices that govern industry operations, which can either enable or impede firms based on how they innovate their business models. The *culture* dimension relates to the shared societal values, beliefs and norms, that shape what is considered legitimate among consumers and other societal stakeholders. Innovations that challenge dominant cultural values may face resistance, necessitating the development of new values or ideas to achieve broader acceptance. The *market* dimension concerns the

preferences, needs, and purchasing behaviors of users or customers such as price or performance. For a value proposition to achieve market viability and commercial success, it must accord with these customer preferences. Lastly, the *policy* dimension involves the overarching regulations that determine what is legal, as well as protective measures specific to the niche that shape the regulatory environment in which the firm operates.

Navigating these socio-technical dimensions through BMI requires niche firms to employ various empowerment strategies. The success of these firms depends on their ability to either align with or challenge existing socio-technical structures. This reflects two empowerment strategies: 'fit-and-conform' and 'stretch and transform' (Smith and Raven, 2012). The fit-and-conform strategy involves innovating within the bounds of the existing socio-technical systems to make "innovations competitive within unchanged selection environments". Conversely, the stretch-and-transform strategy seeks to enact "changes in mainstream selection environments in ways favorable to path-breaking niche innovation" (Smith and Raven, 2012, p. 1025). Huijben et al. (2016) further elaborate on these strategies in their BMDS study by introducing the concepts of 'future fit' and 'future stretch,' indicating a temporal dimension to strategic orientation. Previous research has applied the BMDS to examine the impact of policy on BMI within sectors like solar photovoltaics and to examine BMI related to electric vehicles (Huijben et al., 2016; Wesseling et al., 2020). Yet, despite the emerging recognition of business models as intermediary mechanisms in the interaction between firm activities and socio-technical transitions, the dynamics of how business models both influence and are influenced by their socio-technical contexts remain underexplored (Huijben et al., 2016; Lüdeke-Freund, 2020). This research gap underscores the need for further exploration of the reciprocal influence between business models and their socio-technical environments.

Inspired by the notion of the BMDS, Lüdeke-Freund (2020) closely aligns with its logic to highlight the role of business models in bridging firm- and system-level perspectives via the business model mediation space. This space comprises the "totality of decisions and activities that sustainable entrepreneurs pursue to align their business models with their innovations and business cases, their specific sociotechnical contexts, and stakeholder relationships" (Lüdeke-Freund, 2020, p. 674). This approach acknowledges the critical role of innovative business models in transitioning niche firms beyond their initial contexts to achieve broader impact, essentially acting as 'translation devices' that facilitate the commercialization of new technologies (Bolton and Hannon, 2016; Chesbrough and Rosenbloom, 2002).

While not explicitly adopting the terms 'mediation space' or 'BMDS', Donner and de Vries (2021) also emphasize the importance of aligning business models with the socio-technical environments. They propose a framework highlighting the need for business model alignment across different action levels, including adaptation to macro-political trends and fostering collaboration with adjacent industry actors. Their categorization of business model innovation strategies as defensive, accommodative, or proactive reflects the innovation extent within the business model, considering the socio-technical context both as an influencing factor and one that can be influenced by the business model itself. While this approach echoes the BMDS, it assumes that actors possess a comprehensive understanding of their socio-technical environment, potentially overlooking gaps in their interpretation. To address this, integrating dynamic capabilities may offer a promising avenue for better capturing firm-level agency in interpreting and navigating their socio-technical contexts.

2.3. Dynamic capabilities

Emerging from the literature on strategic management, dynamic capabilities has extended more static explanations for firm-level competitive advantage rooted in a resource-based view by shifting attention to the ways in which firms are able to flexibly adapt and respond to a changing and uncertain external environment (Haarhaus and Liening, 2020; Teece, 2007; Teece et al., 1997; Teece and Pisano, 1994). Dynamic capabilities are defined as the "firm's ability to integrate, build, and reconfigure internal competences to address, or in some cases to bring about, changes in the business environment" (Teece, 2018, p. 40). The term 'dynamic' pertains to the evolving nature of the business environment, whereas 'capabilities' refer to a firm's proficiency in aligning itself with these environmental shifts (Teece and Pisano, 1994). This adaptation involves modifying business processes, market positions, and expansion strategies (Teece and Pisano, 1994). In essence, the strength of a firm's dynamic capabilities significantly influences its proficiency in designing its business model (Teece, 2018). Prior work exploring sustainable business models of start-ups has shown how dynamic capabilities act as drivers that stimulate business model innovation (Oliveira-Dias et al., 2022). Moreover, dynamic capabilities not only enable firms to adapt to their environments but also enhance their ability to shape those environments (Teece, 2007). It is widely recognized that the capability to influence the external environment—such as shaping cultural developments or altering regulations—can be crucial for creating new markets and conditions that support innovative value propositions and business models (Teece, 2007; Walrave et al., 2018). Therefore, dynamic capabilities serve as a vital link between the innovation of business models and the evolving external context of the BMDS.

The efficacy of a firm in designing or redesigning its business model hinges on its higher-order dynamic capabilities: sensing, seizing, and transforming (Oliveira-Dias et al., 2022; Teece, 2007, 2014; Teece, 2018). These capabilities are intertwined with the entrepreneur's skills, encompassing entrepreneurial consciousness, imagination, and action (Teece, 2014); and their execution is as dependent on art and intuition as on science and analysis (Teece, 2018). Sensing involves identifying and shaping future business model opportunities through activities such as scanning, creation, learning, and interpretive action (Teece, 2007), including understanding customer needs that a firm's products or services can fulfill (Teece, 2018). This ability varies across different firms, influenced by access to diverse information and knowledge (Teece, 2007). Seizing relates to innovating the business model to capitalize on identified opportunities, often requiring novel combinations of business model components (Teece, 2018). However, limited understanding of the institutional environment can lead to errors in designing business models and supporting institutional structures (Teece, 2007). Thus, seizing opportunities is a complex and even artistic process, necessitating educated guesses and the application of tacit skills and knowledge (Teece, 2007). Lastly, transforming involves continuous renewal of the business model, the firm, and its environment to sustain evolutionary fitness and leverage business model opportunities (Teece, 2007, 2014, 2018).

3. Methods

3.1. Research design

This study employs an exploratory qualitative case study design to address our research questions: how do insect firms sense the available opportunities within the BMDS, and how do they innovate their business models to seize these opportunities and transform the BMDS? Exploratory case study approaches are especially appropriate for conducting research aimed at gaining a deep understanding of new and contemporary phenomena that are theoretically novel, and where the boundaries to the surrounding context are not distinctly defined (Eisenhardt and Graebner, 2007; Yin, 2018). This makes an exploratory case study approach particularly suited to studying BMI in an emerging niche where the boundaries are still in the process of being understood and formed. Given the nascency of the field and the small number of active firms, the sampling approach was inclusive, aiming to capture a broad cross-section of firms that had been involved in the development or

commercialization of insect-based products or services in Sweden. In total, seventeen firms were identified as having been active in the Swedish insect sector between 2015 and 2023, based on public information and validation from an industry insider. All firms were contacted with a total of 10 firms agreeing to participate, representing more than half of all firms known to have operated in the Swedish market during this period. Sweden was selected as a geographical context to aid analysis across cases within a consistent market, regulatory, and cultural environment.

3.2. Data collection

Data for the present study were collected through online semi-structured interviews with key informants from each firm. This approach, leveraging the semi-structured format, was instrumental in gathering complex data in response to open-ended questions while maintaining the adaptability to tailor the interviews based on participants' responses (Yin, 2018). For example, the interviewees were encouraged to elaborate on interesting deviations to the pre-prepared questions where this could support the development of a better understanding for the study. Additional follow-up queries were made via email when necessary to clarify or augment information obtained from the interviews.

To gain insights into the historical development of each firm, including the strategic choices made in relation to BMI, it was necessary to engage senior members from each organization. For the start-ups, interviews were conducted with the entrepreneurs, while for the established company, interviews were conducted with senior managers overseeing the insect-related business. All interviews were conducted in English, recorded, and transcribed for detailed analysis. We initially used auto-transcription software during the interviews and subsequently reviewed all transcripts to correct any errors or inconsistencies. The transcription process resulted in 87,902 words over 175 pages. To deepen our case study understanding, we complemented the semi-structured interviews by reviewing various secondary data sources. This included a book on the insect industry in Sweden and the cultural shift toward eating them (Engström, 2018), as well as company websites, blogs, and news articles. Details of the interviewed firms, along with the firm specific sources of secondary data, are presented in Table 2. Notably, four of the interviews were completed with firms who have ceased operations, an additional firm ceased operations following the interview. For the purpose of this study, the success of the firms in navigating the BMDS was not the primary concern, rather the ways in which they navigated the BMDS. Consequently, insights from these ceased firms were deemed relevant and contributed to addressing our research questions. The average duration of each interview was 56 min. The interviews were conducted between January and May 2023.

3.3. Data analysis

Our study employed thematic analysis as the overarching method for interpreting the collected data, combining template analysis (King et al., 2017) with a Gioia inspired method (Gioia et al., 2013; Magnani and Gioia, 2023). This mixed approach enabled greater flexibility, supporting different degrees of induction and deduction within our analysis, as well as greater flexibility in the hierarchical levels of coding (Braun and Clarke, 2006; Brooks et al., 2015). Fig. 1 summarizes the overarching analytical framework, which we detail in the following subsections. Although represented sequentially, the actual analytical process was iterative and dynamic.

3.3.1. Step 1: Data familiarization and narrative construction

Common with most thematic approaches (Brooks et al., 2015), our analysis commenced with a thorough immersion in the empirical data to familiarize ourselves with its content and meaning. This involved extensive reading and re-reading of all the transcripts, during which significant terms, phrases, and initial thoughts were identified and highlighted. To facilitate deeper understanding, we created firm-specific narratives (Appendix 1). Similar to analytical memoing in grounded theory, these narratives served as building blocks for sensemaking (Miles et al., 2020), supported reflection (Bell et al., 2022) and the accumulation of supporting evidence (Eisenhardt, 1989; Magnani and Gioia, 2023). Initially, the narratives offered generic descriptions of the firms and their business models. As the analysis progressed, we iteratively refined them to incorporate insights from later stages of analysis. Consequently, the narratives evolved to become "children of the prevailing framework" (Dubois and Gadde, 2002, p. 554).

3.3.2. Step 2a: Initial open coding of interview data

Following familiarization with the empirical material, we conducted an initial round of open coding assigning descriptive labels to relevant segments of the interview transcripts (Braun and Clarke, 2006; Saunders et al., 2016). This process was facilitated using NVivo software. Although focusing on emergent insights from the data, positioning of the study within business model research sensitized codes to the themes of value creation, capture, and delivery. For instance, the segment "we used their side stream…it was a win-win situation" was coded as 'win-win side stream usage' in the informants' terms and then grouped under the more interpretive theme of 'collaboration', broadly aligning with the concept of value delivery. These early codes and themes formed the basis of a foundational data structure, comprising first-order concepts (informant-centric labels) and second-order themes (researcher interpretations). This structure served as the common starting point for all three subsequent analytical pathways (3a-3c).

Table 2
Interviewed Firms.

Interview no.	Pseudonym	Founded	Business Status	Interviewee Role	Duration (minutes)	Secondary Data Sources
1	Firm 1	2016	Ceased	Co-founder	60	Financier website
2	Firm 2	2016	Active	Co-founder	78	Firm website
3	Firm 3	2016	Ceased	CEO and co-founder	75	Firm B2B website, firm B2C website
4	Firm 4	2014	Active	Founder and former CEO	60	LinkedIn post by founder with promotional video
5	Firm 4	2014	Active	CEO	53	Firm website
6	Firm 5	1980	Ceased	Founder	60	Online article about the firm
7	Firm 6	2022	Active	Co-founder	35	Online article about the firm
8	Firm 7	2018	Ceased	Founder	45	Founder promotional video, online article about the firm
9	Firm 8	2017	Ceased	Co-founder	33	Online blog post
10	Firm 9	2019	Active	Co-founder	58	Firm website
11	Firm 10	1881 (Insect R&D initiated 2014)	Active	R&D Manager & Production Manager	51	Online article about the project

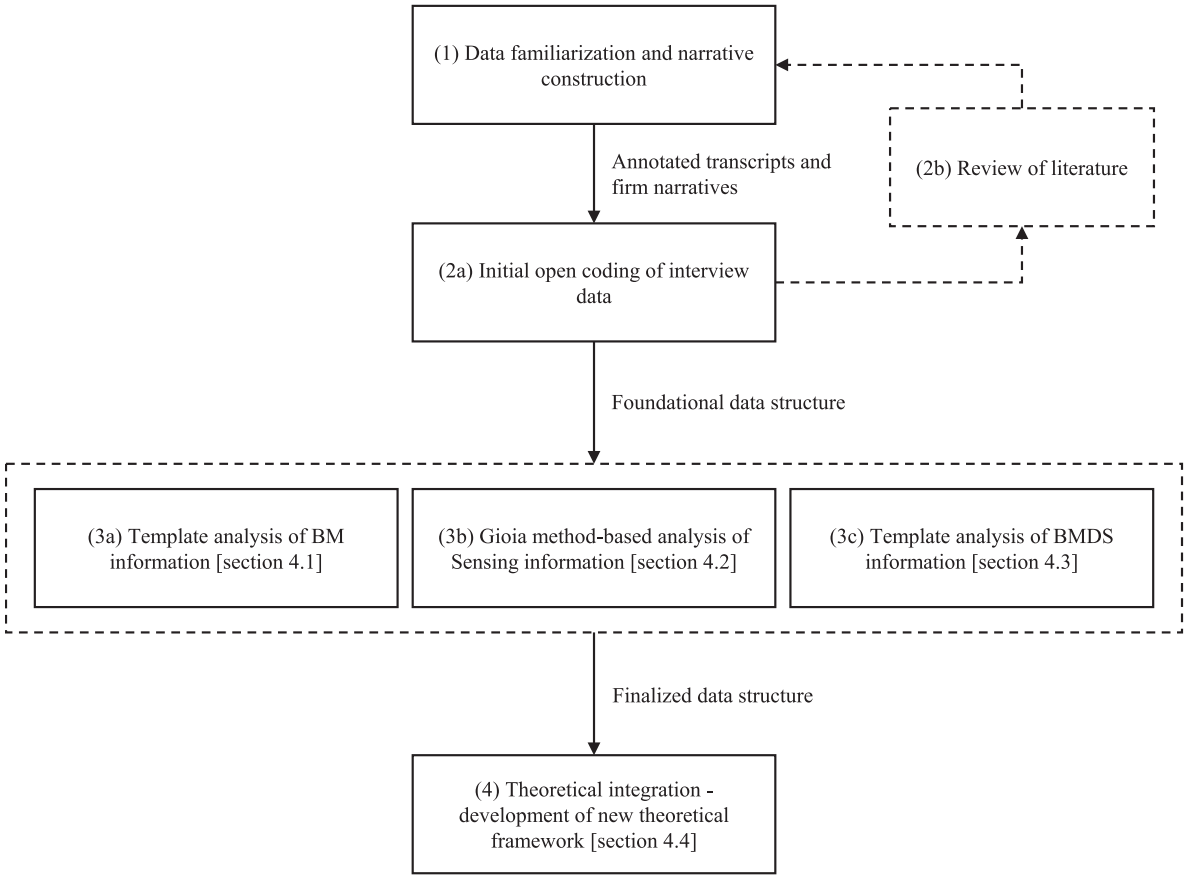

Fig. 1. Data analysis.

3.3.3. Step 2b: Review of literature

Conducted in parallel with the open coding, a review of literature pertinent to the area of study was undertaken. Integrating literature at this stage supported the refinements of emerging themes and patterns, facilitating a better fit between data and theory (Dubois and Gadde, 2014). For example, our initial theoretical orientation toward niche business models was revised in favor of the BMDS framework (Dubois and Gadde, 2002; Wesseling et al., 2020), which provided a better framework for linking firm actions to system-level dynamics. This reflects the iterative, evolving nature of systematic combining, where theory begins as an initial lens for interpreting reality but evolves alongside ongoing analysis (Dubois and Gadde, 2014).

3.3.4. Step 3a: Template analysis of BM information [section 4.1]

Building on the foundational data structure developed in 2a, we applied template analysis to structure the business model data. Template analysis is a flexible form of thematic analysis that supports a structured yet adaptable integration of both inductive and deductive reasoning for thematically organizing and analyzing textual data (Brooks et al., 2015; King, 2004; King et al., 2017). Thematic analysis allowed us to draw on both the inductively identified first-order concepts from step 2a and deductive categories drawn from BMfS value functions and their associated design themes (Lüdeke-Freund et al., 2024). For instance, the deductively identified value function proposing value, and its associated design theme of efficiency, were linked to the inductive first-order concept of 'making a product that's high-protein and low in sugar and fat' through creation of the second-order theme 'offering improved functional performance'. This combined approach retains an element of inductive emergence from the initial coding, while aligning the data with a theoretically informed framework. Organization and visualization of the template is flexible to the researchers needs (Brooks et al., 2015). Reflecting this, our resulting data structure includes four hierarchical levels of coding, incorporating the additional third-order theme level not typically found in Gioia based analyses (Brooks et al., 2015) – see Appendix 2.

3.3.5. Step 3b: Gioia method-based analysis of Sensing information [section 4.2]

In contrast to the template-based analysis of business model information, our investigation of firm sensing activities adopted a predominantly Gioia-inspired approach (Gioia et al., 2013; Magnani and Gioia, 2023). Building on the preliminary coding and data structure from step 2a, we engaged in an iterative process of moving between empirical data and theoretical insights to achieve a close fit between data and theory (Gioia et al., 2013; Magnani and Gioia, 2023). First-order concepts captured informant-centric phrases (e.g., "it was like hands in the soil, you know"), which were then grouped into second-order themes informed by our interpretive understanding (e.g., "learning by doing"). Ultimately, these second-order themes were connected to the higher-level aggregate dimensions of intuitive and systematic sensing, anchored in the dynamic capabilities literature (Gioia et al., 2013). While the concept of sensing served as a theoretical guide, the analysis itself was principally inductive, setting it apart from the more deductively driven approaches used in steps 3a and 3c (Gioia et al., 2013; Magnani and Gioia, 2023).

3.3.6. Step 3c: Template analysis of BMDS information [section 4.3]

With the BMDS framework established as central to our study, we returned to the foundational data structure and conducted a template analysis to examine the BMDS information (Brooks et al., 2015; King, 2004; King et al., 2017). In this analytical step, coding was organized around the two BMDS boundary dimensions of "fit-and-conform" and

"stretch-and-transform", reflecting a more deductive orientation compared to the inductive approach used in the sensing analysis. For example, the statement "it's not like you're working into an existing market. You're creating a new market" was coded as 'market creation' under the broader 'stretch-and-transform' category. In this way, initial codes developed in step 2a were connected via a second-order theme to the third-order theme deductively informed by the BMDS framework. This enabled us to map empirical data onto theoretical constructs in a structured manner, benefitting from both the deductively informed categories and inductive analysis of first-order concepts.

3.3.7. Step 4: Theoretical integration – development of new theoretical framework [section 4.4]

After completing the three separate yet interconnected analysis (3a-3c), we summarized the insights in the corresponding findings section (4.1, 4.2, and 4.3). Writing these findings formed part of the data analysis, with the writing about themes, drawing on the case narratives and connecting them with illustrative quotes, helping to create a coherent understanding of the study findings (King, 2004). This interpretative work resulted in the development of a finalized data structure shown in Appendix 2. Although depicted in a linear and sequential fashion in Fig. 1, reaching the finalized data structure was an iterative and messy process (Dubois and Gadde, 2002). Finally, theoretical integration across business model value functions, sensing activities, and BMDS strategies facilitated the development of a novel theoretical framework, capturing the interconnections revealed through our analysis.

4. Findings

4.1. Insect firm business models

This section presents the business models of the insect firms including a summary of their missions; see Table 3. To support the development of this table, we created ten case narratives, one for each firm, see Appendix 1. These narratives provide complementary, firm-specific accounts of their histories and business model developments. The business models are presented according to six value functions: *proposing*, *delivering*, *capturing*, *maintaining*, *unlocking*, and *sharing value*. Understanding each firm's business model was essential for analyzing how they sense new BMDS opportunities and enact the BMDS to either fit-and-conform or to stretch-and-transform its boundaries; see sections 4.2 and 4.3.

Proposing value refers to the benefits offered to address the needs of a target group. We found that all the firms offer value propositions leveraging the novelty of insects when compared with market alternatives [1−10]. (The use of [..] refers to the relevant firm). Insects are either utilized as a novel technology in converting feed to protein [1,3,10], as subjects of novel services [9], or as novel products themselves, either as the final product or as part of it [1–8, 10]. For example, Firm 8's premium insect-based cracker bread represents a novel product in the market. Furthermore, the utilization of insects offers efficiencies to the customer in terms of reduced costs and improved environmental performance through better resource utilization [1–8, 10]. For instance, through the valorization of waste streams, proteins produced from insects can offer both improved environmental performance and cost reductions by optimizing inputs [1, 3, 10].

Delivering value relates to the ways in which firm connects to a target group to fulfill the promise to the customer. Three primary approaches emerged, direct B2C sales via a company website [2–4, 7], B2C sales through selected retailers [2–4, 8], and a direct B2B approach [1–3, 5–10]. Some firms also employ a combination of these approaches [2, 3, 8]. The specific activities for delivering value are shaped by the value proposition being offered. For example, Firm 3 utilizes all three approaches. First, they sell their frass bio-stimulant fertilizer directly to consumers through a self-developed B2C website, creating a direct link to customers and eliminating intermediaries. Second, they distribute this product via selected gardening retailers, expanding their reach and offering customers an alternative purchase channel. Lastly, their B2B products are sold directly to food, feed and pet food customers, aiming to foster longer-term relationships.

Capturing value refers to how a firm secures its revenues and profits. We observed that revenues are either secured through one-time transactions [4], on a recurring basis [1, 5, 6, 10] or a combination of both [2, 3, 7–9]. For example, Firm 9 generates recurring revenues through a subscription-based model for insect breeding individuals, whilst also earning transaction revenues from lab-based analysis services. This dual revenue approach not only diversifies income streams but also fosters "close communication with the customers" that supports a more sustained engagement.

Maintaining value pertains to the preservation of ecosystems and resources, as well as the functionality of man-made materials and infrastructures. We found that most firms have organized business model activities around this value function [1–3, 5, 9, 10]. For example, diverting industrial side-streams for use as inputs in insect production helps maintain value by avoiding waste and redirecting resources away from more environmentally harmful alternatives, such as biogas production [1,10]. Several firms also maintain value by reducing resource consumption [2, 3, 5]. For example, Firm 3 has implemented a policy to avoid using food as input for insect protein production, focusing instead on "transforming residue streams". Additionally, they have focused on minimizing resource consumption by leveraging efficiencies from a vertically integrated and semi-autonomous production facility, which also strives to reduce customer costs [3]. Firm 5 has explicitly considered the ethics of protein production, stating that conventional "animal production will need to change in the future…the way that we keep, for example, pigs will not be accepted by consumers in the future". Instead, they argue that rearing insects offers a more defensible position than conventional protein sources, thereby maintaining value [5]. By selecting an insect species native to Sweden for its breeding facility, Firm 9 is actively working toward maintaining ecosystems that are sensitive to invasive species [9].

Unlocking value refers to the utilization of untapped potential to create sustainable value by engaging customers and markets. All of the firms have organized business model activities for unlocking value [1–10]. For example, a common design theme is the unlocking of value through valorization of industrial side- and waste streams [1, 3, 10]. While similar to the maintaining value function, unlocking value differs in the sense that instead of being focused on waste avoidance new value is created. For example, Firm 3 seeks to valorize inputs such as "broccoli stems, residual wheat bran, and things that are burned today". Several of the firms unlock value by influencing purchasing behaviour by either removing the "yuck" factor of insects [4] or appealing to health-conscious consumers [2]. Unlocked value is also facilitated via a stimulation for demand from food trials at schools [3], tasting events [7], food fairs [8], aspirational promotions appealing to health conscious consumers [4], the development of more attractive organoleptic food profiles [5, 6, 8], and clearer communication of the importance of quality control for insect breeding – "you want to optimize the quality and output for your companies" [9]. Additional approaches for unlocking value include lobbying activities that seek to make sustainable offerings accessible [3, 8].

Sharing value involves engaging stakeholders to achieve a fairer distribution of benefits and opportunities. The primary way in which insect firms' business model activities support value sharing is through investing resources to realize their missions [1–10]. All the firms have expressed missions focused on resolving issues related to ecosystem preservation or mitigating the effects of global warming, see Table 3. By channeling resources into their companies, they support the environmental causes central to their missions, such as Firm 1's position that "it (the business) was mainly, let's call it mission driven innovation". Additionally, several of the business models support the sharing of value

Table 3
Insect firm business models.

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
Mission	Address the global problems of overfishing and excessive food waste	Accelerate the global transition toward sustainable insect proteins	Valorize residual waste streams for a more sustainable protein supply	Accelerate the global transition toward sustainable insect proteins	Develop more resource efficient and ethical protein production	Revolutionize the food system through sustainable insect proteins	Change consumer behaviors to normalize insect consumption	Accelerate the global transition toward sustainable insect proteins	Develop sustainable and quality-controlled services in insect breeding	Develop more sustainable waste stream valorization technologies
Proposing Value	Planned to offer a novel fish meal substitute with improved environmental performance. Subsequent scaling challenges resulted in short-lived pivot to high-end, non-allergenic pet food market	Offering novel protein ingredients and products with improved environmental performance.	Offered novel protein ingredients and complementary products (ecological fertilizer) with improved environmental and functional performance.	Offering novel insect-based food products with improved environmental performance. Focus on product branding.	Offered live insects for sale as exotic animal feed. Attempted pivot (failed) to offer insect-based food for human consumption.	Plan to offer novel categories of hybrid food products incorporating insect ingredients	Planned to offer high-protein snacks for human consumption targeting health-conscious consumers	Offered novel and premium insect-based products	Offering genetically improved and quality-controlled house crickets for breeding. Offer lab analysis services Operate a breeding facility and lab environment.	Plan to offer novel protein feeds with an enhanced sustainability profile from production based on valorized waste streams
Delivering Value	Plan for direct B2B sales.	B2C product sales via website and selected retailers, and direct B2B sales as suppliers	B2C frass bio-stimulant sales via website and selected retailers, direct B2B sales of food, feed, and pet food ingredients	B2C sales via food retailers and direct sales via web shop	Direct B2B sales to zoos and animal parks	Plan for direct B2B product sales	Planned for B2C sales via website and direct B2B sales	Plan for direct B2B and B2C sales	Direct B2B sales that focus on establishing long-term relationships through additional support services	Plan for direct B2B sales
Capturing Value	Plan for recurring revenues from product sales to B2B customers	Transaction and recurring revenues through product sales	Transaction and recurring revenues through product sales	Plan for transaction revenues through product sales	Recurring revenues through product sales to the same customers	Plan for recurring revenues with longer term customers	Planned for transaction revenues (B2C) and recurring revenues through product sales with partners (B2B)	Plan for recurring revenues through partnership (B2B), and transaction revenues (B2C)	Plan for recurring revenues - subscription-based model of insects. Transaction revenues of lab services.	Plan for recurring revenues with longer term customers
Maintaining Value	Biogas facility collaboration an attempt (failed) at diverting waste from more environmentally harmful energy production.	Exploring development of circular feeds	Avoiding waste through the development of a frass fertilizer product. Streamlining processes through vertically integrated and semi-autonomous production. Company policy to not use food as input to production – reducing resource consumption through supply chain residuals		By offering insects as food the firm sought to introduce more ethical alternatives to conventional animal proteins. Reducing resource consumption through high resource efficiencies converting feed to insect proteins.				Selecting an insect native to Sweden avoids risks of creating an invasive species	Avoiding waste by valorizing inputs for insect production. Diverting waste from more harmful application in biogas production.

(*continued on next page*)

Table 3 (*continued*)

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
Unlocking Value	Valorizing industrial side-streams (not classified as waste) through insect production process.	Influencing purchasing behaviour by appealing to health consciousness	Valorizing industrial side-streams through insect production process. Lobbying for changes to Swedish insect regulations. Facilitating informed decision making by educating on product specifications Food trials in schools to stimulate demand and influence behaviour	Stimulating demand through aspirational promotions appealing to health consciousness Influencing purchasing behaviour by removing "yuck" factor from marketing	Experimenting with alternative cricket species, feeds and recipes with professional chef to unlock attractive flavor profiles for human consumption	Experimenting with different hybrid product compositions to unlock attractive organoleptic profiles	Stimulating demand for insect-based products and testing consumer perception at tasting events	Lobbying for changes to Swedish insect regulations. Influence purchasing behaviour - premium branding. Collaborating with professional kitchen for product development to unlock value Stimulating demand for insect-based products, testing consumer perception at food fairs	Influencing market development through new, quality assured, and scientific practices for insect breeding Facilitating more informed decision making through better information of benefits and risks associated with insect breeding	Experimenting and developing new techniques to unlock the value from waste streams that can be used as input to insect production
Sharing Value	Supporting environmental cause through direct investment in company mission	Supporting environmental cause through direct investment in company mission Plan for employing local women for social impact and local economy contribution	Knowledge sharing with adjacent industry actors to support their transition into insect farming Cooperating with other insect industry producers to share best practice and research results Supporting environmental cause through direct investment in company mission	Kickstarter campaign for funding opened opportunity for external investment Supporting environmental cause through direct investment in company mission	Supporting environmental cause through direct investment in company mission	Supporting environmental cause through direct investment in company mission	Supporting environmental cause through direct investment in company mission	Cooperating with other insect industry actors to share knowledge Supporting environmental cause through direct investment in company mission	Academic research roles support dissemination of latest research knowledge Supporting environmental cause through direct investment in company mission	Extensive R&D collaborations and industry networking to develop and share knowledge Supporting environmental cause through direct investment in company mission

through activities that create social impact in local communities [2], encourage knowledge sharing with adjacent industry actors [3], and disseminate knowledge and best practices [3, 8–10]. Further, Firm 5 offered the opportunity for external investors to become involved in financing the company via a Kickstarter campaign [5].

4.2. BMDS sensing activities

This section presents the sensing activities employed by each of the insect firms to identify and interpret opportunities within the BMDS; see Table 4 for a summary. Based on our analysis, we found two main ways firms approached sensing activities, *intuitive sensing* and *systematic sensing*.

Intuitive sensing reflects a reliance on instinct, experience, and entrepreneurial judgement. This type of sensing tends to focus more narrowly, emphasizing local and inter-industrial perspectives. Our findings indicate that intuitive sensing is the predominant method employed by the insect firms analyzed [2, 4–8]. An illustrative example is Firm 8, a company conceived during a brainstorming session, aimed at identifying market opportunities for innovative food products. After considering different alternatives including vegetable-based products, the firm eventually opted for insects, which they deemed to be a "larger growing market…(where) this sustainable protein was an expanding one". With no prior experience of insects, the founders drew upon their background in previous ventures to guide their strategic direction. This intuitive process was also evident in their product development strategy, which was largely informed by feedback from "testing with friends and small events fairs" regarding their insect-based crispbread. Reflecting the narrower and inter-industrial perspective of intuitive sensing, Firm 8 primarily engaged a network of stakeholders in the insect industry, "sharing practices, talking once in a while", seeking to obtain knowledge and experiences from within this emerging niche.

Systematic sensing involves structured approaches to data collection and analysis. Firms adopting this method typically rely on formal research methodologies, comprehensive data analysis, and forward-looking trend forecasting. The scope of sensing is broader, encompassing global and cross-industrial perspectives. Our analysis indicates that a subset of the insect firms, specifically four, predominantly adopt this systematic approach to sensing [1, 3, 9, 10]. A case in point is Firm 3, where the genesis of the company was rooted in "a research collaboration with [an agricultural university] regarding protein expression". The project's success in securing substantial academic grants allowed the founders to delve deeply into the exploration of climate-smart proteins. The decision to concentrate on mealworms as a protein source was driven by internal data analysis, which highlighted mealworms as being "very, very energy efficient…we have measured our carbon footprint… meet(ing) 1.5 kilos of carbon dioxide per kilo dried mealworm. That's amazingly low compared with other animals". Furthermore, Firm 3 has embraced cross-industrial collaboration, such as working with pig farmers to gain insights into their practices and technologies, in addition to engaging with global incumbents in the processing industries. This broader and more collaborative approach exemplifies the systematic approach to sensing. Additionally, Firm 3 employs structured field trials to collect product data to guide improvements and innovation.

4.3. Insect firm enactment of the BMDS

This section examines how the insect firms enact each BMDS boundary, identifying whether their strategies reflect a fit-and-conform or stretch-and-transform approach; see Table 5. We present our findings beginning with the *market* boundary and followed by *culture*, *industry*, *policy,* and *science and technology*.

Most insect firms innovate their business models to fit-and-conform to existing *market* boundaries [1–5, 7, 8, 10]. For example, firms developing insect-based feeds position them as direct substitutes for traditional alternatives, competing on familiar metrics like amino acid

Table 4
Insect firm sensing activities.

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
Sensing Activities	Cross-industry collaboration, learning by doing, incubator and accelerator program, informal breeding research, experimental analysis (*Systematic*)	Learning by doing, trial-and-error experimentation, networking with industry (*Intuitive*)	Research & development, innovation competitions, learning by doing, market research, product field trials, cross-industry collaboration, data analysis (*Systematic*)	Learning by doing, networking, kick-starter campaign, product testing, narrow market research, opportunistic (*Intuitive*)	Acquisition of earlier business, learning by doing, product testing, collaboration with other insect actors (*Intuitive*)	Networking with other insect actors, market survey, leveraging prior food industry experience (*Intuitive*)	Industry networking, internships at other insect companies, master thesis research, incubator support, product tasting events, learning by doing (*Intuitive*)	Pre-market testing – food fairs and family, leveraging prior food industry experience, networking with other insect actors, learning by doing (*Intuitive*)	Participating in university incubator program, regulation scanning, global market scanning, innovator school, research and development (*Systematic*)	Structured research and development, technology scouting, testing business cases, research collaborations, industrial collaborations, prior professional experience (*Systematic*)

Table 5
Insect firm enactment of the BMDS.

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
Market Boundary	*Fit & Conform:* B2B product substitution – benchmarking performance parity with existing fish feeds *Stretch & Transform:* Developing a new waste management market – valorization for insect feed	*Fit & Conform:* B2B product substitution – supplying functional ingredients for food processing. B2C protein bar appealing to established expectations of similar products	*Fit & Conform:* B2B protein substitution – food, feeds, and pet food. Strategic choice not to pursue fish industry due to onerous scaling challenges *Stretch & Transform:* Developing a new B2C market for frass	*Fit & Conform:* B2C protein bar appealing to expectations of sports nutrition market with 'clean' ingredient list and high protein content	*Fit & Conform:* Continued supplying an established market for exotic animal feed. Early-stage experimentation production for food	*Stretch & Transform:* Challenging the development of new consumer habits through a hybrid category of insect products	*Fit & Conform:* Developing a high-protein snack that would appeal to expectations of consumers with an active lifestyle	*Fit & Conform:* Developed premium category crispbread product	*Stretch & Transform:* Developing a new market for professional insect breeding and analysis	*Fit & Conform:* B2B product substitution – benchmarking performance with existing animal feeds. *Stretch & Transform:* Developing a new waste management market – valorization for insect feed
Culture Boundary	*Fit & Conform:* Small-scale product testing to confirm assurance of technology use case. Product marketed based on established functional properties	*Fit & Conform:* Functional ingredients conform to expectations of food processors. Protein bar framed to meet expectations of gym goers	*Fit & Conform:* Product marketing focusing on technical specifications – to meet B2B customer expectation. Organic certification and circularity for B2C customers	*Fit & Conform:* Product targeted at health-conscious consumers (climbing community), deemed to be early adopters	*Fit & Conform:* Noncontentious supply of insects as feed to exotic animals	*Stretch & Conform:* Developing an insect granola and a novel 'minced meat'-hybrid product	*Fit & Conform:* Product targeted at health-conscious consumers interested in the beneficial properties of insect protein	*Fit & Conform:* Intentionally downplayed the inclusion of insect protein ingredient	*Stretch & Transform:* Challenging the legitimacy of existing niche practices for breeding and quality control	*Fit & Conform:* Product marketed based on established functional properties
Industry Boundary	*Stretch & Transform:* New collaboration between incumbent waste management actor and start-up in adjacent industries	*Fit & Conform:* Sourced insect protein ingredients and products within niche	*Stretch & Transform:* New collaboration between incumbent process industry actor and start-up in adjacent industries	*Fit & Conform:* Engaging existing value chains with ingredient suppliers, bar manufacturers, and retailers. Opted for brand development to avoid high labor costs in Sweden	*Fit & Conform:* Continued delivering insects to long established customers	*Fit & Conform:* Collaborating with other new entrants within the insect niche	*Fit & Conform:* Sourced insect protein from within the niche	*Fit & Conform:* Sourced insect protein from within the niche, co-development of product with professional kitchen	*Stretch & Transform:* Advancing practices for improved quality control	*Fit & Conform:* Incumbent actor internally developing new waste stream processing technology through insect production
Policy Boundary	*Fit & Conform:* Targeted fish feed due to established regulatory approval. Altered side-stream supply of insect feed to comply with waste legislation	*Stretch & Transform:* Lobbying for more stringent quality control of insect producers in Thailand (*non-BMI*)	*Fit & Conform:* Initially targeted animal feed and pet food – extant regulatory approval – later food *Stretch & Transform:* Lobbying for changes to the Swedish regulations on human insect consumption (*non-BMI*)	*Fit & Conform:* Circumvented Swedish legislation through international sales	*Fit & Conform:* Complying with regulations	*Fit & Conform:* Strategically timed their launch following an anticipated relaxation of regulations for human consumption of insects	*Fit & Conform:* Ceased operations due to regulatory restrictions concerning human consumption	*Stretch & Transform:* Lobbying for changes to the Swedish regulations on human consumption of insects (*non-BMI*)	*Stretch & Transform:* BMI advocates for greater oversight and assurance of insect production	*Stretch & Transform:* Researching heat treatment of currently prohibited waste streams as a potential future supply of insect feed
Science & Tech Boundary	*Stretch & Transform:* Developing new production system for insect feed using industrial side-streams as production inputs	*Fit & Conform:* Utilizing established practices and technologies to produce insects	*Stretch & Transform:* Developing new production system for insect proteins – novel side-stream inputs in a vertically integrated facility (breeding, rearing, and processing)	*Fit & Conform:* Utilizing established practices and technologies to produce insect-based product	*Fit & Conform:* Utilizing established practices and technologies to produce insects	*Fit & Conform:* Utilizing established practices and technologies to produce insect-based product	*Fit & Conform:* Utilizing established practices and technologies to produce insect-based product	*Fit & Conform:* Utilizing established practices and technologies to produce insect-based product	*Stretch & Transform:* Incorporation of the founders' research expertise from ecology and animal sciences into Firm 9 advances science and technology boundary within the emerging niche	*Stretch & Transform:* Funding several international research projects to advance understanding of waste management with insects (*R&D*)

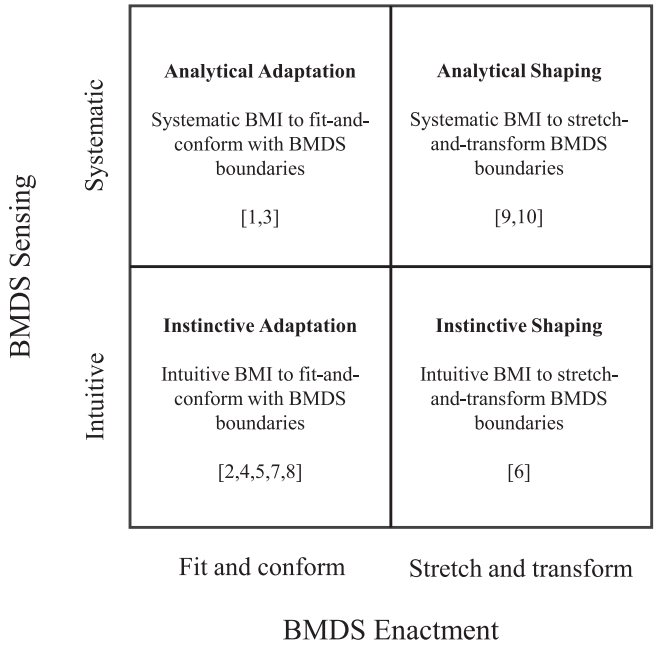

Fig. 2. A typology showing how firms navigate the BMDS.

profiles and solubility, rather than emphasizing the uniqueness of using insects [1−3,10]. Similarly, firms in the sports nutrition market design insect-based snacks to achieve "texture…and taste in a sensible way" [4], and to have the same organoleptic properties and high-protein content expected from conventional products [4, 7]. In contrast, two firms adopt a stretch-and-transform approach to the market [6, 9]. Firm 9, for instance, is pioneering a new market for professional insect breeding and scientific analysis services, challenging informal insect DNA trading by introducing quality-controlled and more transparent operations that stretch-and-transform established practices and norms. Three firms that fit-and-conform also adopt elements of stretch-and-transform, using a hybrid approach [1, 3, 10]. While aligning their products with current market expectations, they are also exploring new opportunities, such as waste management applications [1, 10] and commercializing the frass byproduct from insect farming [3]. In these cases, the stretch-and-transform strategy has greater future orientation, focusing on emerging markets, while fit-and-conform focuses on immediate market integration and consumer acceptance.

Most insect firms adopt a fit-and-conform strategy toward the *cultural* boundary [1–5, 7, 8, 10]. Insects as a source of food or feed are relatively unfamiliar in Sweden, where negative reactions and the "yuck factor" pose a significant challenge [2]. To navigate this, many firms, especially those targeting human consumption, focus on making insects invisible in their final products [2, 4, 7, 8]. For example, Firm 8's cricket-flour crispbread closely resembles other premium crispbread products in the market. Moreover, the company adopted a bug-hushing approach, explicitly avoiding any "references whatsoever to crickets or sustainability or like that in our branding". This approach aligns their value proposition as closely as possible with existing consumer cultural expectations. In contrast, two companies take a stretch-and-transform approach [6, 9]. Firm 6, for instance, is developing novel categories of food products, including a hybrid minced meat incorporating insects. These new categories, like hybrid minced meat, challenge existing consumer expectations and rely on building new demand and cultural acceptance (Grasso and Jaworska, 2020). Firm 6 recognizes that this is their greatest challenge, "the acceptance from the consumers…we have a long way to go there". By developing such products, they aim to stretch cultural boundaries and shift consumer perceptions.

We find that seven out of ten insect companies adopt a fit-and-conform approach to navigating *industry* boundaries [2, 4–8, 10]. Five of these firms align with the emerging insect sector by sourcing ingredients and collaborating within this niche [2, 5–8], while one partners with established actors in the food manufacturing sector [4]. Another firm, already active in waste management, is internally innovating new methods for processing waste streams [10]. Despite varying industry contexts, these companies collaborate in ways that adhere to established norms. For example, firm 4, despite using insects as a novel ingredient, works closely with retailers and bar manufacturers. They noted that "if you called them tonight, you can have a new bar tomorrow labelled", highlighting how easily their product fits into conventional industry practices. In contrast, three firms employ a stretch-and-transform strategy [1, 3, 9]. Firm 3, for instance, is stretching industry boundaries by collaborating with pig farmers transitioning into insect rearing. The firm views this collaboration as mutually beneficial, with the pig farmers having "a lot of experience in equipment and practices that can be useful in the insect industry as well". Additionally, Firm 3 partners with global process industry actors interested in insect protein production, creating new networks that bridge insect-based food, the process industry, and livestock production, establishing connections previously non-existent within these industries.

Most insect firms fit-and-conform to the *policy* boundary, though their approaches vary [1, 3–7]. Due to the lack of regulatory approval for human consumption under the Swedish application of the EU Novel Foods Act (Amelin, 2020), two firms shifted to animal feed [1,3], while another maintained its exotic animal feed focus [5]. One firm targeted international sales to bypass Swedish restrictions on insect-based food [4], reflecting how companies navigate compliance through adaptation and avoidance. Firm 6 "waited until after the (policy) approval", strategically timing their market entry to avoid EU pre-market authorization challenges [6], while another ceased operation after missing the transition period for human consumption sales [7]. Conversely, some firms have pursued a stretch-and-transform strategy. As Wesseling et al. (2020) noted, these firms can stretch regulatory boundaries through non-BMI activities of lobbying [2, 3, 8]. For example, Firm 3 created a branch organization to lobby the Swedish government for policy changes. Others leverage BMI and R&D to press for regulatory changes [9, 10]. For example, Firm 10's research into the heat treatment and sanitation of currently prohibited waste streams to "hygienist (clean) this material" points to the potential of R&D in stretching the policy landscape. Finally, Firm 9's business model represents the initial steps into formalizing breeding practices and policies for insects to better mirror that of the "200 year old" practices for animals where "the breeding industry is massive". These efforts highlight how firms both adapt to existing regulations and actively seek to reshape them through advocacy, R&D and BMI.

We find that most insect firms fit-and-conform to the *science and technology* boundary [2, 4–8]. Firm 4, for example, leveraged existing knowledge and technologies from the food processing industry to create protein bars made from insect flour, without generating new technological insights or innovations that pushed the science & technology boundary. This aligns with Wesseling et al. (2020), who suggest that influencing the science and technology boundary stems from R&D efforts. Yet we find that four firms adopt a stretch-and-transform approach [1, 3, 9, 10]. Firm 1, for instance, developed an innovative insect feed production system using industrial by-products as input materials. Through innovation of their business model, such as shifting from mealworms to black soldier flies and collaborating with a biogas company and a juice manufacturer, Firm 1 pioneered new knowledge and developed new production processes "that proved it's possible to produce insects in Sweden". This challenges the view that a stretch-and-transform orientation depends solely on traditional R&D. Instead, firms in the emerging niche of insect-based food and feed intertwine technological advancements directly with BMI, rather than treating them as sequential or separate.

4.4. Toward a typology of how firms navigate the BMDS

Based on our findings, we propose a typology to explain how firms navigate the BMDS, focusing on the relationship between how firms sense opportunities and constraints, either systematically or intuitively, and how they seize these opportunities through BMI. This process aligns with how firms enact the broader boundaries of the BMDS, characterized as either a fit-and-conform or stretch-and-transform enactment, as depicted in Fig. 2. In doing so, we address the two research questions for this study: How do insect firms sense the available opportunities within the BMDS, and how do they innovate their business models to seize these opportunities and transform the BMDS?

The dimensions of BMDS Sensing and BMDS Enactment in our typology are derived from our analysis and grounded in established theoretical frameworks. BMDS Sensing draws on dynamic capability theory, specifically a firm's ability to sense and identify opportunities within its environment (Teece, 2007). Our findings reveal two primary ways firms engage in this capability. *Systematic sensing* is characterized by a reliance on deliberate, data-driven approaches that rely on structured research and formal analysis. The scope of sensing is broader, encompassing global and cross-industrial perspectives. Conversely, *intuitive sensing* corresponds with a greater reliance on instinctive understanding, entrepreneurial intuition, and experiential insights where firms rely on past experience and personal networks to sense opportunities. This type of sensing tends to concentrate on local contexts and insights from within the industry. BMDS Enactment draws on the concept of empowerment strategies from sustainability transitions literature (Smith and Raven, 2012), describing how firms position themselves within the socio-technical system, either aligning with it (fit-and-conform), or pushing for broader level system changes (stretch-and-transform).

The two typology dimensions of BMDS Sensing and BMDS Enactment are closely interrelated through the process of BMI. The way a firm senses opportunities, whether through systematic or intuitive modes, shapes how it positions itself within the BMDS through BMI, either by conforming to existing boundaries or by attempting to transform them. Business models, therefore, serve as important intermediary mechanisms between firm-level actions and the system level context (Bidmon and Knab, 2018; Bolton and Hannon, 2016; Sarasini and Linder, 2018), both shaping and responding to the broader BMDS.

The typology identifies four distinct seizing modes through which firms navigate the BMDS and seize BMI opportunities, each representing a unique combination of BMDS Sensing and BMDS Enactment: *Analytical Adaptation* (Systematic & Fit-and-Conform), *Analytical Shaping* (Systematic & Stretch-and-Transform), *Instinctive Adaptation* (Intuitive & Fit-and-Conform), and *Instinctive Shaping* (Intuitive & Stretch-and-Transform). While firms may draw on both sensing modes and forms of BMDS Enactment, firms showed dominant tendencies toward specific combinations. We elaborate on the four seizing modes below.

Analytical adaptation is the seizing mode that corresponds to systematic sensing of the BMDS with BMI that aims to fit-and-conform with existing BMDS boundaries. Firm 3 exemplifies this seizing mode, leveraging systematic sensing capabilities grounded in extensive market research and internal R&D to propose value that aligns with established BMDS boundaries. Systematic sensing shaped the selection of mealworms, with internal studies demonstrating high energy-efficiencies and low carbon-footprint, informing the BMI of Firm 3 to become a producer of mealworm ingredients for B2B segments in food, pet food, and animal feed. These value propositions conform to established market expectations by focusing on functional performance metrics such as protein content and amino acid profiles. Further demonstrating a fit-and-conform enactment, Firm 3 avoids direct B2C engagement with insect-based food, instead working within less sensitive B2B contexts to address cultural resistance. Moreover, using supply chain residuals as production process input streams to unlock and maintain value, demonstrates a fit-and-conform orientation to the industry boundary by engaging in existing value chains. These value functions are supported by systematic sensing capabilities built through internal R&D, field trials, and a data-driven focus on improving operational efficiencies and product quality. Similarly, Firm 1 demonstrates analytical adaptation by deploying structured sensing capabilities to understand and align with BMDS boundaries. Through cross-industry collaboration, notably with a waste food processor, it acquired new knowledge that informed the development of an insect-based production system targeted at the B2B fish feed market. Their systematic approach to sensing supported their understanding of the need to demonstrate and match the performance and quality expectations of existing value propositions in the market. By using industrial side-streams as inputs, Firm 1 also exhibits a fit-and-conform approach to the industry boundary, drawing from other production systems. Essentially, Firm 1's BMI aligns with a fit-and-conform approach, particularly in the dimensions of market, culture, and industry within the BMDS.

Analytical shaping is the seizing mode corresponding to systematic sensing of the BMDS, paired with BMI that aims to stretch-and-transform existing BMDS boundaries. Firm 10 exemplifies this mode, having systematically developed their sensing capabilities through the implementation of a comprehensive R&D program. By engaging multiple collaboration partners within Sweden and internationally, the firm is generating new knowledge to inform the interpretation and enactment of the BMDS. As an incumbent actor, it is experienced in navigating its socio-technical context, yet it is simultaneously pushing industry and policy boundaries through the development of a novel, insect-based waste-processing system. This includes R&D trials focused on the heat-treatment of currently restricted waste streams. If successful, this work would enable the firm to propose value in the form of feed-based protein solutions derived from waste, thereby maintaining value by reducing environmental impact and unlocking value through the conversion of low-grade side-streams into marketable products. This represents a stretch-and-transform enactment of the BMDS, informed by systematic sensing. A further example of analytical shaping is evident in Firm 9, founded by two senior academic researchers. Their extensive professional background, combined with ongoing academic research of animal nutrition and conservation biology, underpins the firm's systematic sensing capabilities. Informed by systematic sensing, the firm identified the need for professional breeding services in the insect sector. In response, Firm 9 developed a new value proposition that introduces professional insect breeding and analysis services, embodying a stretch-and-transform enactment by challenging the legitimacy of informal breeding practices and improving quality control expectations. Additional value functions reinforce this transformative orientation, including maintaining value by selecting native insect species that protect local ecosystems, and sharing value by disseminating knowledge and best practices. These combined efforts, informed by systematic sensing capabilities, demonstrate a stretch-and-transform enactment of the BMDS through analytical shaping.

Instinctive adaptation is the seizing mode that corresponds to intuitive sensing of the BMDS, combined with BMI that aims to fit-and-conform within existing BMDS boundaries. Firm 8 exemplifies this approach through the development of a premium insect-based crispbread, designed to align with the established market, culture, and industry boundaries. The idea to enter the food industry via insect-based products emerged from a brainstorming session exploring novel product categories, with the final decision to pursue this path was based on the co-founders' prior start-up experience and a shared interest to do something interesting in the food space. Their process was characterized by trial-and-error learning, with product development guided by informal feedback from friends, small events, and food fairs. Through the development of a premium brand with clean packaging, the firm designed their value proposition to avoid 'hippie' vibes, reflecting a fit-and-conform approach to the cultural boundary. However, one co-founder later reflected that the firm may have had more success if it had pursued a B2B segment, which typically exhibits less cultural

sensitivity. This instinctive adaptation mode involves intuitive sensing capabilities, where personal insights and connections are used to propose value in ways that are culturally and commercially acceptable. Firm 4 similarly demonstrates this seizing mode through the development of a value proposition targeting the climbing community, a decision directly influenced by a team member's active involvement in that scene. In seeking to unlock value through aspirational promotions aimed at health-conscious consumers, and to share value via a Kickstarter campaign that invited broader community participation, they further reinforce this intuitively sensed business opportunity. This highlights a defining feature of instinctive adaptation, a typically narrower focus compared to analytical adaptation, with a greater emphasis on exploiting locally relevant opportunities based on lived experience and personal connections.

Instinctive shaping is the seizing mode reflecting intuitive sensing of the BMDS, coupled with BMI that aims to stretch-and-transform existing BMDS boundaries. A fitting example is Firm 6, co-founded by a serial entrepreneur and a food industry professional, who want to radically transform the food system. Their intuitive sensing capabilities are grounded in one co-founder's prior experience in start-up development and the other's industry insights from working within conventional food production. Rather than relying on a more structured approach, they draw on personal expertise and prior venture experience as part of their instinctive shaping approach. Their ambition to "change the food system entirely" is reflected in their stretch-and-transform enactment across multiple BMDS boundaries. Through the development of novel value propositions, including a hybrid minced meat incorporating mealworm, and a meal worm granola, they aim to propose value that stretches both market and cultural boundaries by introducing a new hybrid product category. These products aim to reshape consumer expectations and cultural norms by introducing insects as a part of everyday foods. Additionally, Firm 6's efforts to unlock value through hybridization represents an attempt to lower the cultural barriers toward insect consumption whilst expanding potential use cases for insect-derived products. This instinctive shaping mode demonstrates an approach more driven by entrepreneurial vision than systematic analysis.

5. Conclusions

This study examines how firms navigate the BMDS through the processes of sensing opportunities and constraints, and subsequently seizing these opportunities through BMI. In doing so, we respond to calls for firm-level conceptual development of the BMDS, specifically accounting for its varied perception by different actors (Wesseling et al., 2020). By integrating dynamic capability theory with sustainability transition literature, we developed a typology that captures the interaction between firm-level agency and broader system-level dynamics. Analyzing ten firms in the emerging niche of insect-based food and feed in Sweden, we demonstrate how the BMDS both shapes and is influenced by BMI processes. This reciprocal interaction underscores the strategic agency of firms and deepens our understanding of how firms can navigate and influence their socio-technical contexts. Our findings offer several implications for theory and research in this domain.

First, our study introduces a novel typology that articulates how firms navigate the BMDS through two interrelated dimensions: BMDS Sensing and BMDS Enactment. We show that firms sense the BMDS either systematically or intuitively, and enact their context by either fitting and conforming to existing boundaries or stretching and transforming them, highlighting the role of business models as intermediary mechanisms (Huijben et al., 2016; Lüdeke-Freund, 2020). The typology clarifies how firms innovate within the BMDS and sheds light on how these innovations impact broader sustainability transition dynamics. It identifies four distinct seizing modes: *Analytical Adaptation*, *Analytical Shaping*, *Instinctive Adaptation*, *Instinctive Shaping*, that combine different approaches to sensing and enactment. By linking firms' interpretations of the BMDS to either a fit-and-conform or stretch-and-transform strategies, the typology offers a novel perspective of the varied degrees of transformative agency firms exhibit. Some operate within existing socio-technical systems, while others actively seek to reshape them.

Second, our study advances BMDS theory by explicitly integrating dynamic capabilities as the mechanisms through which firms engage with, respond to, and reshape the BMDS. While BMDS theory has been used to connect firm-level behaviour with the broader socio-technical system (Huijben et al., 2016; Wesseling et al., 2020), it has paid limited attention to how individual firms interpret these conditions to strategically act upon them. Our typology operationalizes the dynamic capabilities of sensing, seizing, and transforming as central to a firms' ability to construct actionable interpretations of the BMDS. Importantly, this framing challenges the idea that the BMDS is a given; rather it is socially constructed through firms' interpretations and actions. This reframes the BMDS not only as a set of external constraints, but as a dynamic space of strategic engagement. In doing so, we foreground the role of firm-level agency in BMDS theory, showing how firms enact different interpretations of the BMDS through different seizing modes.

Third, our study contributes to the literature on BMI and sustainability transitions by highlighting the heterogeneity of firm-level agency in both shaping and responding to system-level changes, an aspect that remains underexplored (Bolton and Hannon, 2016; Boons and Lüdeke-Freund, 2013). Existing applications of the BMDS concept implicitly assume shared boundary understandings among actors. Our findings challenge this assumption by showing firms interpret and respond to them in different ways. We show that dynamic capabilities are the means through which firms generate differentiated boundary interpretations and respond through varied strategic actions. This has important implications for ongoing research employing the BMDS concept, as it not only accounts for how different BMI strategies relate to the BMDS but also supports an understanding of why particular strategies are pursued in the first place. Such insights are vital for scholars employing the BMDS concept because they provide a richer theoretical foundation for understanding the interplay between firm-level innovation and sustainability transitions, highlighting the role of agency in shaping BMDS boundaries.

Furthermore, based on our empirical insights from an emerging niche, we contribute to a growing body of work exploring a firm-level view of sustainability transitions (Boons and Lüdeke-Freund, 2013; Magnusson and Werner, 2023; Sarasini and Linder, 2018; Werner et al., 2022). This research provides several managerial implications that can support niche actors in more reflexively identifying opportunities in their business environments and responding through BMI. While the typology outlines two approaches to BMDS Sensing, systematic and intuitive, we do not suggest that one is inherently superior, nor that this represents a binary choice. Rather, managers should consider the benefits and trade-offs of each sensing approach when assessing opportunities within the BMDS. Notably, in several of the studied cases, a lack of BMDS understanding was cited as a significant factor in the eventual failure of the enterprise (e.g., see the case descriptions for Firm 1 and Firm 4 in Appendix 1). Moreover, implicit in the BMDS concept is that BMI occurs within a broader socio-technical system external to the firm. Niche actors should be cognizant that their choice of BMI strategies will impact these boundaries and, consequently, their business model in different ways (fit-and-conform vs. stretch-and-transform). For example, two distinct approaches to the market and cultural boundary emerged between the *Instinctive Adaptation* and *Instinctive Shaping* groups. The former substituted insect ingredients into established products to meet existing demand (fit-and-conform – Firm 8), whereas the latter adopted a bolder strategy by developing new hybrid categories of food products to create new demand (stretch-and-transform – Firm 6). For niche actors in the insect industry, we specifically highlight the potential of market orientation (B2B vs. B2C) to circumvent cultural barriers associated with insects in countries such as Sweden. Finally, we emphasize that BM design is as much about what is deliberately included as what is consciously excluded. For example, Firm 3 intentionally excluded the

fish industry as a target customer due to the onerous scaling requirements. In other words, it is possible to fit-and-conform in both negative and positive senses.

Acknowledging the limitations of our study opens avenues for future research, particularly in examining the longitudinal impacts of BMI strategies on systemic transitions and the evolving interplay between the BMDS boundaries and firm-level activities in emerging niches. Further investigation into the scalability of business models in such contexts would enrich the literature on sustainability transitions, providing deeper insights into the mechanisms through which emerging niches can achieve mainstream acceptance and success.

CRediT authorship contribution statement

Linus Thomson: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Chattraporn Chatthong:** Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Thomas Taro Lennerfors:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Chat GPT 4o in order to refine language and improve clarity. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Appendix 1. Firm narratives

1.1. Firm 1

Firm 1, founded in 2016, was founded to address the global problems of overfishing and excessive food waste. By rearing insects on food processing side-streams, the start-up aimed to valorize waste to produce a sustainable fish feed. Initially, Firm 1's business model revolved around producing mealworms. However, this strategy ran into difficulty with an unsuccessful funding pitch to a major Swedish agricultural actor. The key feedback from this rejection centered around the mealworms' lengthy 10-week production cycle, which was seen as inefficient compared to the quicker, six-week cycle of the chicken industry. This critique led Firm 1 to pivot toward rearing black soldier flies, a move that drastically reduced its production cycle to a more competitive three weeks.

During this period, Firm 1 engaged a fish farmer interested in insect-based feed. This connection led to collaboration with a biogas company. Firm 1's founders were employed part-time at this company to develop a technology demonstrator for insect production, using types of waste less suited for biogas but ideal for rearing insects. However, Firm 1 soon encountered legal obstacles that prohibited the use of waste classified as such for insect production. In response, it secured a supply of side-stream leftovers, not officially deemed waste, from a juice processing company. This shift allowed Firm 1 to demonstrate its technology. Yet, despite this success, the initial fish farmer partner withdrew its interest, citing the risk of trialing the feed as too high. Further complications arose in finding a smaller farm for trials because the demand for high-volume fish feed from larger producers remained a daunting barrier. These larger players required immense quantities of insect feed, around 20,000 tons per year, and also sought market redundancy to ensure supply security.

In light of these challenges, Firm 1 began exploring the pet food market as a staged approach to scaling. It identified an opportunity to produce non-allergic, insect-based pet food, which could be sold at a premium price due to its unique properties. However, this pivot presented a dilemma, as it temporarily diverted it from its core mission to reduce overfishing. Despite these strategic shifts and having received both an entrepreneurship award and 2 million SEK in funding, Firm 1 faced the stark reality of financial sustainability. The lack of immediate sales led to the decision to cease operations after two years.

1.2. Firm 2

Founded in Thailand by a team of Swedish and Thai entrepreneurs, Firm 2 is committed to “saving mother earth” by promoting a shift to insect-based proteins. Initially, the company ventured into farming sago beetles but, following challenging sales in what was deemed a promising market, pivoted toward crickets, which could utilize more sustainable feed sources. Central to its business model is the advantage of lower labor costs in Thailand and the region's favorable climate for insect farming. Moreover, Thailand presents an established market for insect-based products, given its cultural acceptance of insect consumption. Firm 2's product line includes cricket powder for B2B food processors and protein bars for the B2C market. These products are designed to overcome consumer reluctance to consume insect-based foods and remove the “yuck” factor, targeting health-conscious individuals and early adopters. The company primarily markets its products in Thailand and Japan and has expanded to Finland, the United Kingdom, Germany, and Indonesia, seeking more lenient regulations than those in Sweden. In an early phase of development, the company's operations were unexpectedly challenged by seasonal flooding, necessitating a change of location for production. Unlike other insect producers who often use industrial side-streams, Firm 2 procures feed from external soy feed suppliers. Recognizing the importance of sustainability, the company is exploring the development of more circular feed alternatives, such as those based on algae and hemp. Firm 2 has faced regulatory challenges regarding feed types and financial difficulties during the COVID pandemic. Despite these setbacks, the company has drawn interest from Japanese firms and is actively seeking further investments. Through the employment of local women, the firm plans to create social impact and contribute positively to the local economy in the next stages of expansion. To elevate industry standards, Firm 2 advocates quality inspections across Thai insect farms to ensure that poor practices in one farm do not adversely affect the entire sector.

1.3. Firm 3

Firm 3, founded in 2016 by two Swedish entrepreneurs, was driven by the potential of insects to revolutionize the future protein supply. Their collaboration began in 2012, in a research project on protein expression with an agricultural university. They subsequently won several large grants for the development of climate smart proteins. The mealworm became their focus, with internal data analysis highlighting its energy efficiency and low carbon footprint. Initially, they faced a challenging regulatory environment and legal issues in Sweden, which was stricter than other European countries. This was highlighted by the founder's remark, "it's very hard to start a new company in a field where you aren't allowed to sell your products", and the observation that "there are so few insect companies in Sweden (due to) strict interpretations of EU laws". Despite these obstacles, Firm 3 secured substantial private investment. It focused on the food, pet food, and animal feed sectors, excluding the fish feed industry, citing the latter's high volume demands and challenging pricing as detrimental to scaling up. Its B2B product range included whole insects, refined products including oils, fats, and protein concentrate, and a novel B2C fertilizer product from the insect's frass targeted at gardeners. Frass is a new product that had shown promise in Firm 3's initial field trials in both grape and apple production, although more research and product development is required for the B2B market.

The company collaborated with adjacent industries – in particular, pig farmers who wanted to make the transition to farming insects. This collaboration was deemed mutually beneficial, with the pig farmers having "a lot of experience in equipment and practices that can be useful in the insect industry as well". Aiding the development of its business model was its practice of networking with insect producers from across the world, such as Lithuania, Norway, Germany, and the USA, encouraging collaboration "to avoid reinventing the wheel". By using insects to valorize residual side-streams, it diverted input resources from the more ecologically harmful alternative of biogas production. Firm 3 was active in lobbying for changes to Swedish insect regulations. Due to the immaturity of the industry, it was not able to procure sub-services such as egg production, so it managed these processes in a vertically integrated setup. In pursuit of efficiency, it continually scanned for new technologies and invested in industrial factory automation to reduce manual labor requirements. It had multiple collaborations with global incumbent actors from the process industries that saw the potential of the operation. However, despite its leadership in the emerging niche of insects as food and feed, the firm filed for bankruptcy in 2024, unable to secure the partnerships necessary to scale operations and achieve economic viability.

1.4. Firm 4

Founded in 2014, Firm 4 emerged from a group of friends inspired by a United Nations report highlighting the potential of edible insects as a sustainable protein source. Despite initial challenges, such as restrictions on selling insects as food in Sweden and missteps in market analysis, it launched an insect crispbread product in Denmark, where edible insects were legal. Despite being initially given shelf space by a Danish supermarket in the belief that it was "bigger than it was", this opportunity was short-lived due to slow sales. Following the departure of two founders, Firm 4 pivoted to producing a cricket-based chocolate bar. This product was introduced through a successful Kickstarter campaign and targeted the climbing community, known by the founder for its openness to new products and a culture that aligned with the product. However, it candidly admitted that the product would "have been even better without the insects". While Firm 4 developed a distinct brand for its insect-based product, it encountered challenges with sourcing insect flour due to import restrictions from non-EU countries. The manufacturing of the bars was carried out in Bulgaria, with Firm 4 focusing on marketing. A strategic decision was made to avoid engaging in other aspects of the value chain, such as insect breeding and rearing, due to high labor costs and Sweden's unsuitable climate for insect production. Financial constraints, supplier issues, and sustainability concerns ultimately led to the company's closure in 2019. The business was then acquired by Interviewee No. 5. Under this new ownership, Firm 4 was relaunched, maintaining a focus on cricket powder products. In its new phase, Firm 4 is collaborating with a bakery to produce a co-branded crispbread and is developing cricket bars. The company continues to source ingredients from suppliers and relies on external production partners, such as the bakery. Operating with a small, part-time team, Firm 4 wants to establish a cricket farm in Sweden and is actively seeking grants for this project.

1.5. Firm 5

Originally established in the 1980s, Firm 5, an insect-farming business in Sweden, supplied zoos and pet stores with live insect feed. It was bought by a new owner in 2019 who, inspired by a United Nations report highlighting the potential of insect consumption for global food security, planned to shift production toward human consumption. By purchasing an already existing business, the new owner sought to overcome its prior lack of experience of insects and absorb new knowledge that could be useful for transforming the business. The decision to pivot toward human consumption was driven by the efficiency of converting feed into insect protein and the perceived benefits for animal welfare. The owner noted the contrast between the living conditions of mealworms and pigs and felt that insect farming was more humane. To expand operations, Firm 5 built a small farm from two portable cabins, managed part-time by an employee responsible for producing live feed. However, the venture faced several challenges. Balancing efficiency with the need to supply a diverse range of live insects weekly proved difficult. Additionally, Sweden's regulatory barriers against insect-based food for humans were a significant hurdle. Despite these challenges, Firm 5 continued to innovate, experimenting with various by-products for feeding crickets and collaborating with a chef to develop different flavor profiles for potential human consumption. In 2020, the relaxation of regulations on insect consumption in Sweden presented a new opportunity, but Firm 5 struggled to achieve commercial success. Financial constraints and a lack of external investment for automating production limited the company's ability to capitalize on this emerging market. Consequently, Firm 5 closed its doors in 2021. Reflecting on the venture, the owner recognized the necessity for smaller, more automated operations in countries with high labor costs, such as Sweden. It compared insect farming to continuous production systems seen in industries such as poultry farming, highlighting the potential and challenges of this emerging sector.

1.6. Firm 6

Firm 6, established in 2022 by two co-founders motivated by the potential of insects as a sustainable source of protein, entered the market to "change the food system entirely". Its launch was strategically timed, aiming to leverage recent changes in Swedish regulations that permit insects for human consumption. Juggling its start-up with other professional commitments, it is working to develop two innovative mealworm-based products: a minced meat alternative and a granola product. Its approach benefits from the co-founders' comprehensive start-up knowledge and one co-founder's

extensive experience in the food industry. The core of its strategy is to offer novel products not currently available on the market, such as the hybrid category of minced meat incorporating mealworms. This differentiates Firm 6 from competitors who are integrating insect ingredients into established product categories, rather than creating new ones. Firm 6 conducted a market survey to identify potential customers and discovered that young, urban men represent its most promising initial customer base. Nonetheless, it seeks to broaden its appeal, aiming to create mainstream products suitable for a wider audience. Firm 6 sees its high-protein offerings in schools, hospitals, and care centers but recognizes the challenge of gaining consumer acceptance in a nascent market. The founders have primarily funded their venture through earnings from their other jobs, but they also receive some support from incubators. They remain actively connected with the insect farming community in Sweden, participating in a national business network. Looking forward, Firm 6 aims to position its products as a premium option and anticipate that advancements in automation will play a significant role in the industry's future growth.

1.7. Firm 7

Firm 7's story began in 2017 when its founder attended a bug banquet where Firm 4 was promoting insects as a sustainable food. Intrigued, the founder researched the edible insect industry and completed a thesis in collaboration with Firm 8 on overcoming the sociological barriers to insect consumption, with the personal goal of normalizing insect consumption. In 2018, the founder joined an incubation center, marking the birth of Firm 7. The company focused on creating high protein snacks, with initial product ideas tested at different tasting events. However, Firm 7 faced significant challenges in sourcing cricket powder. Brexit disrupted its British supply chain, and a Danish supplier eventually ran out of stock. With no Swedish suppliers and only bulk options available, the venture encountered logistical hurdles. Moreover, unexpected regulatory limitations in Sweden, which excluded the company from a transition period benefiting earlier market entrants, posed further obstacles. The founder reflected, "If you don't have any possibilities to sell your product, then it becomes really tough, right?". Faced with these challenges, Firm 7 contemplated a move to the pet food market that, in retrospect, it believed would have been a more promising opportunity due to fewer problems around cultural sensitivity. While still advocating the normalization of insect consumption in Western diets, the founder acknowledged the difficulty in altering public perception. This was highlighted during a visit to a 'disgusting food' museum in Malmö, where insects were presented negatively. The founder disagreed with this portrayal, seeing it as counterproductive to the firm's mission. Financial constraints eventually led to closing of the company.

1.8. Firm 8

Firm 8 was co-founded by two former classmates who sought to bring novel food products to market. Following a brainstorm of potential product categories, they opted to innovate in the sustainable protein market. More specifically, they chose to focus on products derived from insects – in this case, crickets – due to their high protein yield and efficient resource consumption. Although having larger visions of running insect production and processing, the duo started by developing and marketing a cricket flour-based crispbread. In a deliberate move to appeal to upscale consumers, they developed a premium branded product and avoided sustainability and cricket-related references in their packaging and branding to avoid the otherwise common and stereotypical "hippie" vibe. An insect industry contact helped them source the insect flour from Thailand, and product development was undertaken in collaboration with a professional kitchen, where the initial test batches were crafted. The product was tested at food fairs and with family members to gauge interest and feedback. However, Firm 8 soon discovered that it faced regulatory barriers in Sweden, where the sale of insect-based food was prohibited. To overcome this, it collaborated with other insect start-ups to petition the Swedish Food Agency, advocating the adoption of European regulations that would allow the sale of insect products. Consequently, facing regulatory hurdles in Sweden, Firm 8 turned to markets in Denmark and Finland, where its products received a positive reception. Attempts to re-enter the Swedish market from Denmark, however, met with limited success. Despite its efforts to influence regulatory changes, it was unable to successfully enter the Swedish market and, ultimately, shut down in 2020. Notably, shortly after its closure, Swedish regulations were amended to permit the sale of insects as food. The venture was primarily self-funded, with some additional support from minor grants. Reflecting on the experience, one co-founder noted that, if given another chance, they would not opt for such luxurious branding. The duo even suggested that targeting the B2B segment might have been more promising than overcoming the cultural challenges associated with establishing a successful B2C brand.

1.9. Firm 9

Firm 9 was founded by two senior researchers specializing in nutrition and conservation biology at a Swedish agricultural university. The company provides house crickets free of a common and detrimental virus to insect farms globally. Its initiation was from that the founders in their research field recognized a significant gap in the specialized insect breeding market. This area is still in its infancy compared to the centuries-old livestock breeding industry. The founders selected the house cricket for its nutritional benefits, appealing flavor, and its approval for human consumption by the EU. Moreover, the house cricket's native status in Sweden decreases the risk to the environment from it becoming an invasive species. The company implements screening and breeding programs to maintain the health of its crickets and provides lab analysis for other insect farmers. It also takes great care in quality controlling the feed, to guarantee the standard and sustainability of their product. It aims to establish a close relationship with customers, offering advice and monitoring insect health. The company has adopted an international approach from the beginning, recognizing the limitations of the Swedish market and the larger potential abroad. A unique aspect of Firm 9's business model is its focus on selling individuals with known heritage that are bred for high genetic diversity. This innovative approach targets insect producers, aiming to shift the industry from its current state of informal cricket trading to a more professional, subscription-based model. This service is enhanced by additional support such as regular health analyses, creating a recurring customer base. It is seeking funding to scale up production and expand its network, emphasizing the need for sustainable and economically viable solutions for trading genetics in the insect industry. Running its business alongside its professional research careers not only ensures it has access to the latest information, but it also facilitates business support from the university holding company.

1.10. Firm 10

Firm 10 is currently in the demonstrational phase of an in-house research and development project. The project's focus is on sustainable protein production for animal feed using organic waste, a natural progression from its primary business in waste recycling. This venture allows it to utilize its existing expertise in identifying potential feed alternatives. This initiative, centered on black soldier fly (BSF) farming, emerged from the company's

ambition to more effectively valorize its organic materials, surpassing the value derived from biogas production. Over the past decade, development has followed a structured approach, starting with small-scale lab studies and advancing to larger technology demonstrations. Collaborations with universities in Sweden and North America have been integral to this process, providing crucial insights for its technology demonstrator. For instance, in 2014, laboratory experiments in collaboration with an agricultural university began to test various compositions of organic waste. The aim was to identify effective upstream supply alternatives for BSF farming, striving to establish a diverse supply chain. This diversity is vital to create a robust system with agile and flexible recipes, reducing vulnerability to supply fluctuations. Firm 10 has engaged experienced professionals in insect production, gaining valuable knowledge and skills to propel its initiative forward. Concurrently, the company is assessing the operating costs and capital investments required for this venture. An active network with industry peers forms a significant part of its strategy, facilitating the sharing of best practices within the insect production industry. However, the company faces regulatory challenges, especially regarding the use of animal by-products in animal feed. Current regulations limit scaling up production using non-animal by-product organic waste, such as household waste, due to the animal by-product regulation. To overcome this, Firm 10 is exploring the heat treatment of waste streams to eliminate pathogens and ensure a safe input for insect production.

Appendix 2. Complete list of codes with illustrative quotes

2.1. Insect firm business models

Illustrative Quote	First-order Concept	Second-order Theme	Third-order Theme	Aggregate Dimension
"we're trying to…produce more sustainable protein to be used in feed production" [10]	Producing a more sustainable protein source for animal feed	Offering improved environmental performance	Novelty	Proposing Value
"we went for cricket crispbread" [8]	Launching a crispbread made from crickets	Offering new product		
Company website – offering analyses of insect pathogens e.g. "densovirus analysis" [9]	Providing insect pathogen analysis services	Offering new services		
"full of protein and less sugar, less fat" [6]	Making a product that's high-protein and low in sugar and fat	Offering improved functional performance	Efficiency	
Company website - "buy online" sales of B2C product [3]	Selling insect-based products directly to consumers online	Sales direct to customer through website	B2C	Delivering Value
"we got it into stores all over Denmark" [4]	Getting product into retail stores across Denmark	Sales through retailers		
"we had an international delivery to Denmark and Finland of a very innovative corporate" [8]	Supplying products directly to international corporate clients	Direct sales to other companies	B2B	
Company website – includes link to purchase insect protein bar B2C [2]	Offering insect protein bar purchases to consumers	One-time transaction revenues	Transaction	Capturing Value
"when it comes to the insects we call it subscription" [9]	Introducing a subscription model for insect products	Subscription-based revenue model	Recurring	
Blog post – "(the firm) will offer a partnership with companies" [8]	Forming ongoing partnerships with other companies	Sustained customer relationship		
"we talked with the CEO of the biogas company and he agreed…they employed us" [1]	Collaborating with a biogas facility that hired services	Biogas facility collaboration	Avoiding waste	Maintaining Value
"we must find a better way to produce the feed and I think we should have seaweed" [2]	Experimenting with new feed ingredients like seaweed	Exploring circular feeds		
"the frass is the insect manure…everything is just transforming into valuable compounds" [3]	Turning insect manure (frass) into valuable by-products	Commercializing production process waste streams		
"We don't want to use something that can be used directly for an animal feed either" [10]	Avoiding feed inputs already suitable for direct animal consumption	Valorizing waste streams		
"we have a statement of the board also that we are not interested in doing food out of food" [3]	Company policy for only using residuals or wastes, not edible food inputs	Company policy for only valorizing supply chain residuals	Reducing resource consumption	
"that is heavily connected to the production of proteins (environmental performance of agriculture)…and the resource efficiency (of insects)" [5]	Emphasizing environmental benefits and resource efficiency of insect-based protein	Improved feed to protein conversion		
"we know that the process works, but to make it more efficient, higher production rates…there's a lot of things that need to be done" [10]	Needing continuous improvements to boost production efficiencies	Streamlining production processes		
"I think that mealworms can have a good mealworm life in a box, I doubt that the pigs have a good life in a box" [5]	Insects are a more ethical alternative to pigs	Insects as more ethical source of protein than conventional animal sources	Ethical responsibility	
"one of the reasons we chose that (species)…is (it) doesn't pose as high risk as some of the other species that (have) invasive species problems" [9]	Selecting an insect species that minimizes invasive risk	Selecting native insect species		
"we went over there and said, 'hey, can we come and get your leftovers?" [1]	Collecting leftover food waste from local partners	Valorizing side-streams	New market development	Unlocking Value
"we want to advise as well as rear (insects)" [9]	Offering consultancy in addition to insect breeding	Offering new type of service or production process with sustainability potential		
Kickstarter campaign video - "crickets have more iron than spinach" [4]	Highlighting that crickets have higher iron content than spinach	Appealing to health consciousness	Influencing purchasing bahaviour	
"the biggest problem of being in the forefront is also having to do the lobbying and fighting" [3]	Lobbying and fighting to change regulations	Lobbying for changes to Swedish insect regulations	Making sustainable offerings accessible	

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Illustrative Quote	First-order Concept	Second-order Theme	Third-order Theme	Aggregate Dimension
Company website – "the (insect) presents a high-quality amino acid profile (EAAI = 1.6)" [3]	Informing customers about insects superior amino acid profile	Educating customers on product specifications	Facilitating informed decision making	
Company website – "our (insects) are: tested for the presence of relevant food pathogens…this will… improve the sustainability of the industry" [9]	Ensuring food pathogen testing to boost industry sustainability	Educating on industry best practices		
"we had some trials (in) schools. They loved our (product)" [3]	Conducting food trials in schools with positive feedback	Food trials in schools	Stimulating demand	
"I had contact with the chef that bought some crickets to…test the quality of the crickets…there is large difference in taste depending on feed" [5]	Working with a chef to refine taste based on different feed inputs	Developing more attractive organoleptic profiles		
"we went for some, you know, initial market tests in fairs in Stockholm that were very open to this type of innovative foods" [8]	Testing consumer acceptance at food fairs in Stockholm	Marketing at food fairs		
"we hope that we could give women in Thailand possibility to have a job" [2]	Creating employment opportunities for women in Thailand	Local employment of marginalized people	Improving stakeholders socioeconomic conditions	Sharing Value
"they have got lots of experience (pig farmer)…that can be useful in the insect industry as well. So it's a mutual collaboration" [3]	Sharing knowledge with pig farmers to aid their transition to insect farming	Knowledge sharing with advancement industry actors to support their transition into insect farming	Offering access and opportunity	
"we were just sharing practices (with other insect firm), talking once in a while once we met" [8]	Exchanging best practices with other insect producers	Sharing best practice with other industry actors		
"the Kickstarter was successful" [4]	Securing crowdfunding support for the business	Opening up opportunity for small-scale external investors		
"let's call it mission-driven innovation. Um, there is this problem with overfishing in the world seas, and we also have a problem with food waste. So, two of those problems could be partially solved by insect farming" [1]	Focusing on solving overfishing and food waste through insect farming	Direct investment in company mission	Supporting environmental cause	

2.2. BMDS sensing activities

Illustrative Quote	First-order Concept	Second-order Theme	Aggregate Dimension
"it was difficult to start to learn…so it was like hands in the soil" [2]	Having to learn by getting hands-on	Learning by doing	Intuitive Sensing
"experimented a bit (in kitchen at home), made some spread, some shakes" [4]	Trying out different recipes and products at home	Trial and error experimentation	
"I've been working with agriculture and climate…also working a lot with climate policies and climate change negotiations" [5]	Using background in agriculture and climate policy	Leveraging prior experience	
"they (insect firm) gave us a contact to the supplier in Thailand, I think they knew them" [8]	Getting connected to a Thai supplier through another insect company	Networking within industry	
"No, we were not connected. I found it (the company) on Blocket" [5]	Discovered the company by chance on Blocket	Opportunistic	
"they (biogas facility) employed us for, uh, 25 %. So we would have housing, a facility where to have insect production" [1]	Working part-time at a biogas facility that provides space for insect production	Cross-industry collaboration	Systematic Sensing
"I was connected to business developers…at the local incubator in Lund University" [7]	Collaborating with business developers at a univeristy incubator	Incubator and accelerator programmes	
"we also have 3 universities and probably like 20 different Phds working on projects" [10]	Partnering with multiple universities and researchers for various projects	Research and development	
"we made a survey to find our target group and it seems to. Be young men in urban areas" [6]	Conducting a survey to identify young men in urban settings as our main target group	Market research	
"we have done some field trials" [3]	Carrying out field trials	Product field trials	
"different types of big data or small data…to help identify new areas for implementing synergies or novel circular technologies" [10]	Analyzing various data sources to find opportunities for circular solutions	Data analysis	

2.3. Insect firm enactment of the BMDS

Illustrative Quote	First-order Concept	Second-order Theme	Third-order Theme	Aggregate Dimension
"that's not what to focus on if you want to build anything of significant scale. You have to be aligned with behaviour" [4]	Needing to align with customers existing behaviour to scale up significantly	Product alignment with established customer preferences	Fit & Conform	Market Boundary
"the problem with the fish industry is that they're high sensitivity on pricing and the high demand of volume…so we have diverted from fish feed market" [3]	Diverting from fish feed market because they want huge volumes at very low prices	Avoiding select customers due to mismatch of expectations		

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Illustrative Quote	First-order Concept	Second-order Theme	Third-order Theme	Aggregate Dimension
"looking into how we can produce protein using insects from organic material that for now, is classified as waste" [10]	Figuring out how to use organic waste to produce insect-based protein	Developing a new market for managing waste and residuals through valorization	Stretch & Transform	
"and we expect actually to make more money out (this new product)" [3]	Expectation that new product will bring in higher revenues	Developing a new market through new products and services		
"we're experimenting (hybridity) with other vegetables" [6]	Experimenting with new insect and vegetables combinations	Developing new hybrid category product		
"we found another, like a super small farmer…we proved that the fish, they grow well on our insect" [1]	Testing insects with a small farmer and showed that they work well for fish	Small scale product testing to confirm product performance to customer	Fit & Conform	Culture Boundary
"the climbing community seemed to like it…it fits their whole culture there" [4]	Climbers embraced the product because it fits their culture	Marketing aligned with cultural values of customer		
"It hasn't really been done before, so it's just if we get acceptance from the markets" [6]	Nobody has done this before, it all depends on market acceptance	Developing product that challenges the values of consumers	Stretch & Transform	
"they (other insect firms) maybe get (insects) from a colleague.. trade individuals, which potentially could work or not work" [9]	Some firms source insects informally from each other, and its uncertain if its viable	Business model activities challenge legitimacy of niche		
"yes, we have contact with other (insect) farmers as well…it's more like we want to work together" [6]	Keep in touch with other insect farmers because of will to collaborate	Collaborating within the insect-niche	Fit & Conform	Industry Boundary
"we buy the feed from companies" [2]	Purchasing feed inputs from established suppliers	Engaging existing value chains for resources and services		
"statement of the annual report mentioned collaboration (with us)" [3]	Annual report highlighted our partnership with them	Collaborations between incumbents and insect start-ups	Stretch & Transform	
"what many are doing (insect breeding)…there's not so much understanding in how you do it professionally" [9]	Many breed insects, but there is limited knowledge on doing it professionally	Advancing practices for improved quality control		
"I called them and had constant conversations with the Swedish Food Agency, and they were also like, no…it's not possible for you" [7]	Kept talking with the Swedish food agency who confirmed it was not allowed	Complying with existing regulations	Fit & Conform	Policy Boundary
"together with them (other insect firm), we opened a little lobbying kind of group and we sent a couple of letters to the Swedish Food Agency to push on implementing the European Regulation in the country" [8]	Formed a lobbying group and wrote letters to push Swedish Food Agency to adopt EU regulations	Lobbying for new regulations	Stretch & Transform	
"we know the family or heredity of all our individuals (to avoid problems of inbreeding), so we can keep track of everything we sell…so it's sort of a more sustainable solution" [9]	Track family line of insects to avoid inbreeding and ensure sustainability	Business model demonstrating importance for new regulations		
"so I carried on with the original business, so to say to produce live insects for mainly reptiles" [5]	Continued producing live insects mostly for reptiles	Utilizing established practices and technologies	Fit & Conform	Science & Tech Boundary
"we have a formal project together with a (University) right now, looking at if we hygienist this material, you know 70 degrees for an hour" [10]	Working with a university to test heating process to hygienist material	Developing new production system	Stretch & Transform	
"this feeding between research and the company in such a way that the company really gets access to basically our brains (academic researchers in ecology and animal science)" [9]	The company gets access to the founders research expertize and knowledge	Advancing R&D frontier through founders		

Data availability

The authors do not have permission to share data.

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