The big bug: The legitimation of the edible insect sector in the Netherlands

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ABSTRACT

This study analyzes the legitimation process of an emerging novel food sector in the European Union (EU). Current EU policies are cautious with regard to new food sources and new food technology, and we aim to determine how the sector is addressing both this caution as well as a general public that may be skeptical of its products. By utilizing a legitimacy strategy framework and conducting 19 semi-structured interviews with actors and experts in the Dutch edible insect sector, we assess the sector’s progress and limitations with regard to its legitimacy journey. The findings show that sector focus has thus far been on organization, intraindustry, and interindustry legitimacy strategies, and that additional emphasis on institutional strategies will be imperative to securing more accommodating legislation. In addition, the lack of a common vision, a strategic communication plan, and interfirm linkages may also be hindering sector legitimation. The framework and conclusions presented here may prove useful to other sectors introducing novel foods.

1. Introduction

With the global human population expected to reach 9 billion by 2050, food security and environmental issues have become priorities for policy makers. The demand for meat alone is expected to increase by 76% (Alexandratos and Bruinsma, 2012). Given the livestock industry’s impact on the environment – deforestation, soil erosion, and, greenhouse gas emissions, and water pollution – increasing production is not a sustainable solution to the future demand for protein (Garnett, 2011; Steinfeld et al., 2006). Moreover, reliance on foreign soybean meal and rising prices of soybean and fishmeal due to an increase in global demand (Van Huis, 2013), the environmental impact of soy production (Veldkamp and Bosch, 2015), and the use of soy in aquaculture (Henry et al., 2015) add urgency to the search for alternative sources of protein.

Insects may be one such alternative. Insects convert their feed to protein more efficiently than livestock (Van Huis, 2013), produce fewer greenhouse gas and ammonia emissions (Oonincx et al., 2010), and require considerably less land to rear (Oonincx and De Boer, 2012). Given its potential as a more sustainable food and feed source, there is a possible market for insect protein. Current European Union (EU) regulations – namely the European Novel Food Regulation – prohibit the production and processing of insects for food on a commercial scale, however. Western society also maintains a general aversion to insects (Verbeke, 2015). In addition, research indicates that European legislators and consumers are cautious with regard to new food technologies (Falkner, 2006; Fell et al., 2009; Gostek, 2016; Rollin et al., 2011). This caution presents a challenge to sectors introducing new food sources to obtain legitimacy for their products.

Legitimacy can be defined as “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995, p. 574). The importance of public opinion and perception in obtaining legitimacy for new technologies has been illustrated in studies on genetically modified organisms (GMOs), biotechnology, and nutrigenomics (Gostek, 2016; Ronteltap et al., 2007; Sylvester et al., 2009). Sectors with novel innovations in food must navigate the bumpy terrain of introducing change in current food production and consumption patterns within a cautious legal and public climate. This research aims to determine how they do so. Specifically, we seek to respond to the question What strategies do sectors introducing novel food or technology implement to gain legitimacy for their products and activities?

Organizations seeking legitimacy for a new technology must implement strategies that place the technology within that society’s culturally-bound belief systems and moral standards (Scott, 2014). Aldrich and Fiol (1994) have developed a legitimacy strategy framework which allows analysis of a sector’s progress in doing so. Although other legitimacy strategy frameworks have also been developed (Erkama and Vaara, 2010; Reast et al., 2013; Suchman, 1995), the Aldrich and Fiol (1994) framework is the most appropriate for our analysis due to its focus on new ventures and specific levels of analyses. Employing the framework should therefore be helpful in investigating the legitimacy strategies implemented by organizations in emerging food sectors. This...
research will do so using the edible insect sector in the Netherlands as a case study.

In recent years, the Netherlands has earned a reputation as a leader in the field of edible insects. The country is uniquely positioned to become a global player in insect protein innovation due to its expertise in climate control, farming, and logistics. We chose to focus on the Netherlands in this study because although current EU regulations severely restrict the production and processing of insects for food and livestock feed on a commercial scale, businesses, researchers, and government in the Netherlands continue to support and pursue innovation in the field (“Kabinet wil,” 2015; Pascucci and de-Magistris, 2013; Veldkamp et al., 2012).

One of the key contributions of this research is that we are analyzing the legitimation process of an emerging sector as it is occurring rather than speculating or piecing together information after the fact (Zimmerman and Zeitz, 2002). We are therefore not dependent upon historical accounts, but can follow the actors, events, and the social and legal context as legitimacy is being pursued. Furthermore, following the legitimation trajectory of the sector throughout its lifetime will not only provide insight into the sector itself, but also potentially into the study of novel food practices in Europe, the tension between policies within the EU, changing social norms, and strategic communication. This research marks the beginning of the study of this emerging sector’s legitimacy trajectory.

2. Theoretical framework: organizational legitimacy

Organizational legitimacy refers to the perception by stakeholders and the public that an organization’s activities are congruent with prevailing norms and values (Suchman, 1995). Deephouse and Carter (2005, p. 332) explain legitimacy as “the social acceptance resulting from adherence to regulative, normative or cognitive norms and expectations.” This acceptance is important because it translates into access to resources and increases the chances of firm survival (Dowling and Pfeffer, 1975; Meyer and Rowan, 1977; Parsons, 1956; Zimmerman and Zeitz, 2002).

Aldrich and Fiol (1994) divide legitimacy into two categories: sociopolitical and cognitive. Sociopolitical legitimacy refers to “the extent to which a new form conforms to recognized principles or accepted rules and standards” (p. 646). Zimmerman and Zeitz (2002) divide sociopolitical legitimacy further into sociopolitical regulatory legitimacy and sociopolitical normative legitimacy. Sociopolitical regulatory legitimacy involves complying with legal and professional standards and regulations. It has been operationalized in previous studies by measuring government agency support and policy establishment (Deephouse, 1996; Golant and Sillince, 2007; Singh et al., 1986). Sociopolitical normative legitimacy involves what is right by way of societal values and norms, procedures, and structures. Previous studies have operationalized normative legitimacy by measuring public support via the media (Deephouse, 1996), professional accreditation (Ruef and Scott, 1998), participation in professional associations (Greenwood et al., 2002), and involvement in professional alliances (Rao et al., 2008).

In contrast to sociopolitical legitimacy, cognitive legitimacy refers to society’s knowledge or understanding of an organizational form (Aldrich and Fiol, 1994; Suchman, 1995). Organizations can increase their cognitive legitimacy by, for example, aligning themselves with other legitimate actors or actions or through discourse that appeals to currently held beliefs or creates new ones (Suchman, 1995).

The laws, norms, and cultural conceptions – that is, the regulative, normative, and cognitive rules that govern behavior (Scott, 2014) – that comprise the institutional conditions within a society influence business strategies, but they can be influenced by those strategies as well.

2.1. Legitimation strategies

One of the obstacles to gaining legitimacy for new industries and organizations is a “liability of newness” (Aldrich and Fiol, 1994; Stinchcombe, 1965). Increased organizational density within a sector contributes to overcoming the liability of newness and increasing legitimacy (Carroll and Hannan, 1989; Hannan et al., 1995; McKendrick and Carroll, 2001): “density is a parsimonious indicator of legitimacy that enjoys predictability for a remarkably wide array of organizations” (Deephouse and Suchman, 2008, p. 55). Density alone, however, is not enough to secure legitimacy; the public must have knowledge of the organizations and be able to recognize and categorize them (Hauns and Hannan, 2005; McKendrick et al., 2003; Navis and Glynn, 2010). Prior studies have found that organizations engage in strategies to increase public recognition and gain legitimacy (for example, Suchman, 1995; Scherer et al., 2013; Tornikoski and Newbert, 2007; Zimmerman and Zeitz, 2002).

Aldrich and Fiol (1994) hold that entrepreneurs pursue strategies designed to acquire social acceptance and recognition for their organizations and the emerging industry of which they are a part. These strategies involve disseminating knowledge about the organization and sector, as well as undertaking activities to build trust, reliability, and a good reputation. The authors divide the strategies into four levels, “beginning with the individual venture and working our way up the hierarchy” (p. 647): organizational, intraindustry, interindustry, and institutional. This study utilizes the Aldrich and Fiol framework because its clearly delineated strategies allow us to apply the framework to the edible insect sector to determine what measures entrepreneurs and sector proponents are taking to improve sector legitimacy. We would like to emphasize that in the Aldrich and Fiol framework, entrepreneurs lead the legitimacy charge, but the strategic efforts toward legitimation of an industry involve many other actors in the field who also have a stake in sector success.

Entrepreneurs employ organizational strategies to spread the word about their product or service and to gain trust. Such strategies include using language that appeals to stakeholders and communicating a vision in terms that mesh with social beliefs but also promise something better. Entrepreneurs may gain cognitive legitimacy by behaving “as if” their products or services are already and accepted truth (Aldrich and Fiol, 1994, p. 651), and sociopolitical legitimacy by disguising “the truly radical nature of their new activity” (p. 652).

Intraindustry strategies enhance reliability and involve collaboration among entrepreneurs to develop sector standards and parameters. When new ventures within a sector are too competitive with one another to work together to position their product(s), they hinder the legitimacy of the entire sector. A common vision or design increases cognitive legitimacy and the development of explicit standards serves to increase sociopolitical legitimacy.

Interindustry strategies improve reputation and include establishing trade associations and cooperation with existing industries. Trade associations serve to increase cognitive legitimacy by creating a sense of a stable sector through activities such as collaborative media campaigns, conferences and trade fairs, and publications. When entrepreneurs cooperate with existing, legitimate industries, they are viewed as reliable, credible partners, increasing not only their own sociopolitical legitimacy, but that of the sector as well (Aldrich and Fiol, 1994).

Institutional strategies that contribute to the cognitive legitimacy of the sector include, for example, the development of industry-focused curricula by educational institutions which serve to spread the word about the industry. Sociopolitical legitimacy of the sector can be acquired when organizations establish collective lobbying operations to influence the creation and scope of regulations and policies (Aldrich and Fiol, 1994).

Summing up the legitimacy strategies, sociopolitical legitimacy is increased through strategic activities that aim to develop trust, reliability, and reputation with stakeholders and institutional backing.
Cognitive legitimacy is increased through strategic activities that aim to develop knowledge.

With regard to the edible insect sector in the West, legitimacy appears to be the sector’s greatest challenge: the public that does not yet view insects as a legitimate food source and the EU maintains a precautionary stance toward food technology. In the Netherlands, producers are actively pursuing legitimacy from the public as well policy makers. The following two sections elaborate on EU policy with regard to edible insects and the Dutch edible insect sector.

3. EU policy on insects as food and feed

Legislation of insects as food and feed is still under consideration at the European Union. Currently, insects may be sold in small quantities if produced for human consumption, and insects may not be processed for use as ingredients. (See Appendix A for background information on the use of insects in food, feed, and pharmaceuticals.) The law governing insects as food and feed is the European Novel Food Regulation (ENFR) which was first established in 1997 (EC 258/97), revised in 2011 (EC 1169/2011), and repealed and replaced in 2015 (EC, 2015/2283). Novel food is considered “food that has not been consumed to any significant degree in the EU before May 1997” (EC, 2015). Producers rearing insects for human consumption are required to submit a novel food dossier complete with safety assessment within two years of the regulation entering into force. The International Platform of Insects for Food and Feed (IPIFF), the European edible insect sector lobby, opposed the two-year timeline, indicating that it was “unrealistic to gather all the necessary documentation required in the NF [novel food] application dossiers” (IPIFF, 2015). In October 2015, the European Food Safety Authority (EFSA) was expected to release a ruling regarding the safety of insects as food and feed. However, their report indicated that more research was needed before further recommendations could be made (EFSA, 2015). The use of insects in pet food is allowed, but use in feed for animals reared for human consumption is prohibited under Regulation EC 999/2001 (EC, 2001) and EC Directive 2002/32 (EC, 2002). The exception is aquaculture; in October 2013 the EU allowed the use of non-ruminant proteins as feed for farmed fish (Van der Spiegel et al., 2013). However, strict slaughterhouse requirements that were not written with insect breeding in mind have hindered the development of this market. In May 2017, as the result of lobbying by IPIFF – the voice of the insect sector in Brussels (“Insect Sector Pleads,” 2016) – the EU passed legislation officially allowing the use of animal protein in aquaculture as of July 1, 2017 (EU 2017/893). (See Appendix B for a list of acronyms/initials used throughout the paper.)

The limits to human and livestock consumption involve safety issues, the main concerns being heavy metals, toxic chemicals, allergens, and pathogens (Van Huis, 2015; Van der Spiegel et al., 2013). However, recent research of fly larvae in animal feed indicated that “with appropriate quality assurance mechanisms and testing regimes in place to monitor chemicals in the larvae then we can conclude that it is feasible to produce fly larvae that are free from chemicals of concern to the animal feed sector” (Charlton et al., 2015, p. 15). Some researchers question the appropriateness of categorizing insects as novel foods as well as their safety risk to consumers (De-Magistris et al., 2015). Van der Spiegel et al. (2013) indicate that there is lack of clarity regarding legislation on insects. For example, issues such as feed/substrates (EC 767/2009, 1069/2009, 142/2011), products of animal origin (EC 852/2004, 853/2004), and feed for pigs and poultry (EC 999/2001; 1069/2009, 142/2011) are not clearly addressed (Van der Spiegel et al., 2013, p. 674). One of the main concerns regarding the use of insects in pig and poultry feed is BSE (bovine spongiform encephalopathy) transmission, yet Van der Spiegel et al. indicate that findings have shown little or no chance transmission from insects to other non-ruminants. They suggest that these findings may have some bearing on future EU legislation with regard to insects in feed.

4. The Dutch case

Notwithstanding the legislative and social hurdles described above, proponents of breeding insects for food, feed, and pharmaceuticals in the Netherlands are continuing to develop the sector. Some of the main insect breeders in the Netherlands are Protix (established in 2009), Kreca/Proti-Farm (established in 1978), Van de Ven (breeding insects since 1999), Meertens (established in 2002), and Vivara (insect breeding activity established in 2011). Koppert, Ruig en Zonen, DeliBugs, and Tasty Bugs are also considered major players in the sector. Protix breeds black soldier flies as its main business. The other companies breed insects such as crickets, grasshoppers, and mealworms for the hobby feed market as their main business or part of an existing business. Additionally, there are several larger organizations that are not yet part of the industry network organizations but which are developing breeding and/or processing facilities. They are not members of insect industry networks, declined to be mentioned in this study, and they have maintained a low profile despite significant research and development investments in the sector.

Professional organizations in the insect sector have also been founded. Venik (Dutch association of insect breeders) was established in April 2008 by a small group of breeders. Current members include Protix, Proti-Farm, Koppert, Van de Ven, Meertens, Vivara, Tasty Bugs, Nostimos, and Amusca. The organization is in the process of professionalizing and has developed a handbook and certification for breeders.

Venik has also been helpful in securing grants from the national government for further academic research into edible insects. Venik and researchers from Wageningen University & Research teamed up to obtain the Supro 2 grant which provided one million Euros in funding for the study of edible insects (Heselmans, 2010; “Minister Verburg,” 2010). In addition, participation in regional and national television and radio (e.g., Ruig & Zonen products on a popular Dutch late-night talk show in May 2015 and an interview with Vivara on a regional business program in January 2016) has allowed producers to share their narrative through mainstream channels.

The Insect Protein Innovation Platform (IPIP) was launched in 2015 by local and regional governments, in cooperation with Vivara. The launch included a trade fair that took place on 21 January 2016. The goal of the platform is to bring together government, business, and education to make the southeast region of the Netherlands a hub of insect innovation in Europe. Insectpoint, a center for applied research and development of edible insects established by Wageningen University & Research, regional government, and entrepreneurs, was opened in Lelystad, the Netherlands in 2014. The International Insect Centre (IIC) is a network, co-op organization established by 15 Dutch organizations whose goal is to accelerate sector development and push for legislation favorable to the sector. IIC has also received local government support in cash and kind. IPIP, Insectpoint, and IIC are just three examples of regional networks and platforms that are being developed across the country.

Support from the Dutch government involves not only creating a forum to discuss issues but also financial support to stimulate innovation and growth in the sector in the Netherlands. Obtaining resources through grants and subsidies is an example of “legitimacy by association” (Baum and Oliver, 1991, p. 189.) National and EU subsidies for innovation in sustainable food and agriculture are being awarded to sector participants. Examples of Dutch subsidy programs applicable to the edible insect sector include WBSo (to stimulate high level research, development, and innovation), Innovatiebox, MKB-innovatiestimulerend Top Sectoreen (“innovation stimulation for SMEs”) and OP EFRO Zuid-Nederland. Regarding EU subsidies, the Horizon 2020 Research and Innovation and Horizon 2020 SME-Instrument are programs to which organizations involved in the production and processing of insects can apply for funding.

The informal networks between the Dutch breeders, policy makers,
and business have also been instrumental in bringing the sector to where it is now. Projects such as Kip & Ei (“chicken & egg”) have been established throughout the sector by research institutes, entrepreneurs, and feed companies to test feeding mealworms to chickens, for example. Additionally, conferences have been organized (e.g., Wageningen, May 2014; Venlo, January 2016) and workshops on insects and insect breeding have taken place (HAS University of Applied Sciences [HAS], 25 March 2015 and 15 March 2016; Wageningen University & Research, 3 November 2015 and 18 February 2016). Researchers from Wageningen and HAS are working with breeders such as Protix, Vivara, Van de Ven, and Protifarm to learn more about breeding, feeding, and processing insects. Most recently, one breeder has been developing plans for Insect Valley with regional and local governments. The aim is to bring together researchers, government, industry, and civil society organizations to develop safe and sustainable insect rearing methods and innovate new products and uses. In June 2017, Protix issued a press statement that it had received 45 million Euros in funding from public and private investors (“Protix receives 45 M€”).

Further growth and survival of the Dutch edible insect sector will require additional sociopolitical and cognitive legitimacy. The strategies necessary to secure legitimacy are the focus of this research; the methods to investigate strategic employment are discussed below.

5. Methods

This research followed a qualitative approach that combines both inductive and deductive methods. Themes from interviews were determined inductively “before returning to the literature and using theories deductively” to provide further explanation (Gale et al., 2013). The objective was not to generate new theory, but rather to learn more about the legitimacy strategies in an emerging sector; the use of an existing framework and interviews allowed us to better understand and explain events in the sector (Yin, 2011). We conducted 19 in-depth, semi-structured interviews with experts and stakeholders including breeders, industry experts, researchers, government officials, and live-stock farmers in the emerging sector. Participants were identified by one of the researchers who attended two conferences, five meetings, and an all-day workshop on edible insects. We also identified interviewees through respondent-driven techniques such as snowball sampling (Heckathorn, 1997; Yin, 2011). With the exception of one participant in higher education and one in government, all of the participants were actively involved in the sector from a research, investment, or policy perspective. Table 1 presents a list of interviewees by sector, scope, and capacity.

The interview questions were designed to elicit responses regarding the weaknesses, strengths, opportunities, and threats of the edible insect sector, as well as possible solutions to the weaknesses and threats. The interviews were recorded, fully transcribed, and lasted between 30 and 87 min. Following Miles and Huberman (1994), we adopted an iterative, comparative coding process “to identify similar phrases, relationships between variables, patterns, themes” (p. 9). The transcriptions were then printed and notes were written in the margins for both categorization and retrieval purposes. The open-coding process resulted in 70 codes which ranged from animal welfare to waste management. These 70 codes were grouped into seven categories which “represent themes in the data and can lead to more abstract, theoretical ideas” (Boeije, 2010, p. 113) by two of the researchers. The categories, identified in a process of consensus by two of the researchers, were public acceptance, cooperation, economic opportunity, regulation and policy, research, scale of production, and sustainability. It is important to note that some of the codes could be placed into one or more categories. For instance, it could be argued that “food” belongs to all seven categories. However, the coders aimed to determine which relationship between code and category was strongest based on the interviews. (See Appendix C for codes and categories.) Interrater agreement regarding which code should be assigned to which category was 72% (kappa is 0.66, which indicates good reliability [Bakeman and Gottman, 1986]).

Table 1

<table>
<thead>
<tr>
<th>Inter-view</th>
<th>Sector</th>
<th>Scope</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>1</td>
<td>Public – Innovation</td>
<td>N</td>
<td>Director</td>
</tr>
<tr>
<td>2</td>
<td>Banking</td>
<td>N</td>
<td>Bank Director</td>
</tr>
<tr>
<td>3</td>
<td>Livestock</td>
<td>I</td>
<td>Small/Medium Business Owner</td>
</tr>
<tr>
<td>4</td>
<td>Industry Consultant</td>
<td>N</td>
<td>Owner</td>
</tr>
<tr>
<td>5</td>
<td>Higher Education Consultant</td>
<td>I</td>
<td>Food Industry Expert</td>
</tr>
<tr>
<td>6</td>
<td>Insect Sector Consultant</td>
<td>I</td>
<td>Owner</td>
</tr>
<tr>
<td>7</td>
<td>Public</td>
<td>N</td>
<td>Regional Government Representative</td>
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<tr>
<td>8</td>
<td>Public</td>
<td>N</td>
<td>Local Government Representative</td>
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<tr>
<td>9</td>
<td>Automation</td>
<td>I</td>
<td>Manager</td>
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<tr>
<td>10</td>
<td>Higher Education</td>
<td>N</td>
<td>Director</td>
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<td>11</td>
<td>Feed</td>
<td>N</td>
<td>Director</td>
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<tr>
<td>12</td>
<td>Public</td>
<td>I</td>
<td>European Union Parliamentarian</td>
</tr>
<tr>
<td>13</td>
<td>Livestock</td>
<td>N</td>
<td>Owner</td>
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<tr>
<td>14</td>
<td>Feed</td>
<td>I</td>
<td>Director</td>
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<tr>
<td>15</td>
<td>Insect Breeding</td>
<td>I</td>
<td>Project Director</td>
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<td>16</td>
<td>Insect Breeding</td>
<td>I</td>
<td>Owner/Entrepreneur</td>
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<tr>
<td>17</td>
<td>Insect Breeding</td>
<td>I</td>
<td>Owner/Entrepreneur</td>
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<td>I</td>
<td>Researcher</td>
</tr>
<tr>
<td>19</td>
<td>Higher Education</td>
<td>I</td>
<td>Researcher</td>
</tr>
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The seven categories are also related directly or indirectly to issues of communication; risk and benefit perception; safety, quality, and cost; trust and social norms; public knowledge; and psychological factors such as naturalness that have been identified in studies on consumer or societal acceptance of novel food and technology (e.g., Costa-Font et al., 2008; Ronteltap et al., 2007; Siegrist, 2008). Though the research described in this paper did not set out to translate the findings in those studies into specific organizational strategies, that was one of the results. This will be elaborated upon further in the Discussion.

In addition to the interviews, a LexisNexis search of Dutch newspapers from 2000–2015 was conducted using the search term “insecten eten” (“eating insects”). A number of other terms were tried – for example, edible insects, entomophagy, “eeetbare insecten” (“edible insects”) – but “insecten eten” is the search term that resulted in the most relevant hits. The purpose of the search was to determine the pattern of concept salience in the media as an indicator of diffusion and awareness. The media provides a general overview of public interest in and knowledge of the sector. Prior studies conclude that the media can serve as an indicator of cognitive and normative legitimacy (Deephouse, 1996; Deephouse and Suchman, 2008; Dowling and Pfeffer, 1975; Hannan et al., 1995; Humphreys, 2010; Pollock and Rindova, 2003). While increased media coverage is not a guarantee of social acceptance, it is an indicator public knowledge and awareness (Aldrich and Fiol, 1994; Deephouse, 1996; Dobrev and Gostopoulos, 2010; Hannan et al., 1995) and what the public perceives to be important (Geels and Verhees, 2011). As media salience of a subject increases, its news value also increases (Bauer et al., 2001). Diffusion of information through the media can also be critical to the establishment of legitimacy of new technologies because the less information and knowledge the public has about emerging food technology, the more
suspicious of it they are (Fell et al., 2009) and the less likely they are to accept it (Cardello et al., 2007).

The salience of media articles alone does not indicate or guarantee legitimacy. The way that issues are framed in newspapers is an indicator of legitimacy (Geels and Verhees, 2011). For example, in their analysis of Dutch media accounts from 1945–1986, Geels and Verhees (2011) illustrate how the issue of nuclear energy gained and then lost legitimacy in the Netherlands by showing how positive newspaper stories were replaced by negative stories over time. When opponents of nuclear energy were able to take over the discourse, the framing of newspaper stories changed from positive to negative.

This research analyzes newspaper stories about the edible insect sector from 2000–2015 to determine whether the stories are framed as positive, negative, or neutral (see Choi and Lee, 2006; Shaw and Giles, 2009; Thøgerson, 2006). Together the researchers coded a simple random sample of 162 of the total 278 articles (to achieve a 5% sampling error using a 95% confidence interval; Neuendorf, 2002). Following Thøgerson (2006), articles were coded as follows: (1) positive or optimistic toward edible insects; (2) negative or pessimistic toward edible insects; (3) neutral or non-classifiable framing of edible insects. In addition, the articles were coded according to the axial codes from the interviews. Each article was assigned a code or codes that represented the context in which edible insects was discussed. The researchers agreed to make a note of new contexts should they arise, yet this did not occur. Analyzing the articles this way would provide insight into (1) the salience of articles about edible insects over time; (2) the tone of the articles over time and; (3) how edible insects are being framed the media over time.

6. Results

6.1. Interviews

6.1.1. Organizational strategies

Twelve of the interviewees (Interview 1, 2, 4, 5, 7, 8, 11, 15, 16, 17, 18, 19) indicated that the Netherlands is uniquely positioned to become a leader in insect protein innovation due to its expertise in climate control, farming, and logistics. Furthermore, there is an urgent need for a new business model as conventional farming and livestock production will not sustain the region economically in the future (Interview 2, 3, 4, 5, 7, 8, 11, 14, 15). Five participants (Interview 4, 13, 14, 15, 16) also stated that the Dutch may not be breeding the insects themselves in the future, but will rather export their knowledge about how to breed the insects and how to build safe breeding and processing facilities. Insect production is framed as a solution to current problems, in terms that stakeholders relate to and understand.

According to eleven interviewees (Interview 1, 2, 3, 4, 7, 8, 10, 11, 13, 16, 17), one of the main drivers of the insect sector is sustainability and the need for sustainable protein alternatives. Interviewees referred to Dutch dependence on soybean meal from Brazil (Interview 1, 2, 4, 5, 8, 10, 11, 12, 13, 14, 15, 16, 17), carbon footprint reduction (Interview 8, 13, 15), feeding the global population (Interview 2, 5, 10, 11, 13, 14, 15, 16, 17), and environmental improvement (Interview 3, 5, 13, 15, 16).

You begin because you think you can make money. Period. And in the end also with the protein question in Europe, all the soy that is imported, environmental issues, sustainability, if you make the link with animal feed then you make the sector more sustainable. The circular economy idea is extremely important, natural fertilizer, local food production.

Interview 3

A sector exists because it meets the needs of customers. I think that the needs of the customer are becoming more and more holistic. People are becoming more aware. There will always be a large part of society that does nothing, but increasingly people are considering the consequences of their behavior and choices.

Interview 16

Interviewees mentioned price (Interview 2, 3, 5, 6, 11, 13, 15), scale of production (6, 7, 11, 19), volumes (1, 9, 12), and mass production (9, 15, 16, 18) as key to the success of the industry. Protix, Enterra (Canada), and Enviroflight (U.S.) have fully automated black soldier fly production and processing.

It’s going to be about volumes. Look, the uses [of insects] are fairly diverse. You see that in all new markets. The focus is often on one sales market even though there are many more markets and uses. Personally, I think the first big uses will be in animal feed and supplements in animal feed and a basis for pharmaceuticals, namely in crèmes and that sort of thing.

Interview 9

All of the interviewees except one (Interview 12) were positive about the potential economic and social opportunities that the insect sector could bring to the Netherlands: new business model, soy/fishmeal alternative, feed market potential, use as an ingredient in other food/feed/pharmaceuticals, and a possible solution to the global protein shortage. However, one interviewee (Interview 14) explicitly stated that sector development should not be rushed and that pursuing a push strategy could endanger the entire project. He also indicated that the feed market should not be the target market at this time. His recommendation was to professionalize, breed for niche markets, and enter other markets only once the cost of production is competitive, larger concerns are involved, and thorough risk assessments and testing have been completed. Another interviewee (Interview 4) stated that urgency plays a large role in what we eat. He compared insects to crustaceans and said that when people got hungry enough they took to eating crustaceans and “did nice things with them, masked them in food, got rid of the smell” and that will happen with insects as well.

Transparency (Interview 4, 5, 6, 17), nudging the market from feed to food (Interview 5, 7, 10, 12), addressing safety issues and the fear of mass production of insects (Interview 2, 4, 6, 8, 9, 11, 15, 16, 18, 19), and getting the consumer used to insects as a solution rather than a problem (Interview 1, 2, 4, 5, 8, 10, 11, 12, 13, 14, 15, 16, 17) are all key to gaining public confidence and support.

People don’t like insects so eating an insect is certainly not what people will be immediately enthusiastic about. If you just use it as a protein alternative and then indeed even one step before that is putting it into feed and not into food, then of course you can build on experience. And at a certain moment, [you have to] communicate, “Well, we have been using that for years now” and then probably it’s much easier to get it accepted.

Interview 12

In this phase, involving the consumer, you need to emphasize the nudging possibilities.

Interview 5

Although twelve of the interviewees indicated that the image of insects poses a potential threat, they were overwhelmingly positive that the public would support insects as feed and ingredients in the short-term and insects as food in the long-term (Interview 1, 2, 4, 6, 7, 10, 11, 12, 14, 16, 18, 19).

In sum, the majority of interviewees were positive about the future of the edible insect sector and communicate it as a possible solution to social, economic, and environmental problems. They describe edible insects not as a radical solution, but compare it to what we know (e.g., crustaceans) and issues that are becoming increasingly important (e.g., sustainability).

6.1.2. Intraindustry strategies

One of the keys to the industry moving forward, according to thirteen of the interview participants, is cooperation among breeders

What I consider another problem is the lack of trust between the insect companies... I always give the example of the windmills in Denmark. In Denmark all the companies decided to work together and now they are the world leader. In the United States they were all competing with each other and they lost the market to Denmark."

Interview 19

Agreement on a dominant design and the communication of that design is also crucial to legitimacy, but the sector has not yet achieved agreement:

[One of the threats to the sector] is poor cooperation [among producers]. When you're in the positioning part of the game, cooperation is difficult. So you have to find parties as soon as possible that you can get things done with.

Interview 17

In my view, it should be a condition [of cooperation] that we don't all try to reinvent the wheel but work together to build up the sector... to consider together how we should approach the very big market that's in front of us so that we can be competitive, be interesting.

Interview 15

Interviewee 16 stated that the sector is making a mistake by not all telling the same story. There is too much of a focus on food – eating insects and publishing cookbooks – whereas the focus should be on feed or ingredients to be added to food and feed. One interviewee (13) stated that insect breeders are not working together because there is currently no demand for the product. When demand is high, they will begin to work together because there will be enough business to go around.

Ten of the interviewees (Interview 1, 2, 6, 9, 11, 12, 15, 16, 18, 19) stated that a concerted lobby effort is necessary for the sector, though the opinions about the effectiveness of VENIK were mixed: "not very important" (Interview 2); "won't make the difference" (Interview 4); not sure – necessary but not sure if effective (Interview 3, 8, 14, 16); good but it needs to be more professional (Interview 11, 17, 18); very important and potentially effective (1, 9, 10, 15); very important and effective (Interview 6, 18).

In sum, based on the interviews, there is little intrasectoral cohesion. Interviewees indicated the need for greater cooperation, but expressed a lack of trust among sector participants.

6.1.3. Interindustry strategies

Fifteen of the interview participants indicated that networks have played a key role in the establishment of the sector (Interview 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18). The term network refers to the networks formed by entrepreneurs, government officials, business, and education. Eight of the interviewees (Interview 1, 2, 6, 8, 10, 13, 14, 18) indicated that retailers and supermarkets were already involved in the sector:

I spoke yesterday to... [founder of a retail company]... and I said, you know, you can't imagine how thankful the sector is to you that you kept all the jars on the shelves. Because usually with that kind of turnover, they'd be gone within three weeks and this whole thing would have been over.

Interview 6

Seven interviewees (Interview 2, 8, 9, 11, 15, 16, 17) stated that cooperation with nongovernmental organizations (NGOs) is important to the future of the sector, but only one interviewee (Interview 17) indicated current collaboration between the interviewee's company and an NGO.

An interviewee in the automation industry (Interview 9) indicated that his company and companies like his are developing technologies and investing in machinery because they believe that insects will be bred and processed in the future. He indicated that his company is working with only a few insect producers at this time, in both Europe and Asia.

Interview 9

Other interviewees stated that the multinational corporations will only get involved in insects if and when they see potential:

If it works then you will see at a certain point that the Nestles of the world will want to buy everything at once, either because they want to scale up themselves or to shut out the competition.

Interview 7

If Mars says we're going to produce on a large scale and we're going to help the sector develop, then you have another story.

Interview 5

One interviewee (Interview 6) mentioned Mars, DSM, and Cargill as potential future players, but indicated that right now they are "just looking" to see what is going on in the market. At the time of the interviews, none of them had been in touch with multinationals about collaboration. Another interviewee (Interview 9) stated that if the market opens up, the large feed and pharmaceutical companies will take control of it.

In sum, according to the interviews, interindustry collaboration is taking place through informal and formal networks as well as investment. The interviewees indicated that multinationals are observing the market but are not yet actively participating in it at this time. More cooperation with NGOs is anticipated.

6.1.4. Institutional strategies

With regard to networking, the term triple helix – collaboration between business, government, and education – was mentioned by six of the interviewees (Interview 7, 8, 15, 16, 18, 19):

I always talk about the golden triangle... I think the Ministry is interested because the Dutch are the second exporter of agricultural produce in the world and they want to keep ahead of all kinds of developments. So the Ministry has always been supportive. I would say of course Venik, let's say the private enterprise, and then of course the academia. That triangle made it really work.

Interview 19

Cooperation between research institutions, entrepreneurs, and government is a critical element for the sector in terms of safety, trust, innovation, and public image. Wageningen University & Research, HAS, University of Maastricht, KU Leuven, and TNO (Netherlands Organization for Applied Scientific Research) were mentioned by the interview participants as partner organizations. Fourteen of the interviewees (Interview 1, 2, 3, 5, 6, 7, 8, 10, 13, 14, 15, 16, 18, 19) indicated that working with the research institutes was essential for testing, validation, and safety studies.

It's extremely important to have things validated independently... you need the proof... We also do tests in our company in cooperation with the HAS and if that comes out (in the press) it's great if the name HAS or Wageningen is attached. It carries more weight.

Interview 3

One interviewee (Interview 16), an entrepreneur, stated that cooperation with researchers and universities is important “to put the sector on the map,” but that the current level of useful research at the universities is “terrible” and not useful in practice.

With regard to collective lobbying and marketing, as indicated above, ten (Interview 1, 2, 6, 9, 11, 12, 15, 16, 18, 19) of the participants interviewed explicitly indicated that a strong lobby presence in the sector is necessary to educate and inform legislators. Concerning lobby efforts at the EU level, this task has gone to IPBUFF. Even with representation in Brussels, however, the legislation process can be tedious:

The European lobby work could have been better. What I've seen so
far is that people that are responsible for that were not completely on the same wavelength which is okay, which is acceptable, but if they would have been and they would have pushed that forward a bit more then maybe, I mean in 1997 we got novel food regulation. Now it’s 2015 and we’re still deciding whether insects are supposed to be novel food or not. I mean, 18 years. This could have gone quicker.

Interview 18

Progress is not occurring as quickly as some would like, and some Dutch companies may not wait around for European legislation to enter the global market:

That company has the technology. If the laws don’t change soon, they’ve already said that they’ll go to India or China because they’ve already got other business there. They’ll develop the know-how here and then they’ll export it.

Interview 17

But also for Protix I know that if the legislation doesn’t come quick, they may go to other countries…If the impediments are too high here in the Netherlands, you know, go abroad.

Interview 19

Breeders are working with researchers, suppliers, and officials to “check off” the most important requirements for the establishment of a new sector, as one entrepreneur put it, so that they are ready for production once legislation is passed:

Number 1: food safety; Number 2: professional/trade organizations; Number 3: when you walk into a factory, safety principles, cleaning protocols…and Number 4 is ‘I need to know something, who do I talk to [to get the answer]?’

Interview 17

The entrepreneur continued by saying that the insect sector will only really exist once businesses involved in the breeding and processing of insects as food and feed are generating cash flows. Yet these cash flows will only exist throughout the sector once EU policies regulating the use of insects in food and feed have been changed.

In sum, according to the interviews, sector linkages with educational institutions have been made and further cooperation is being pursued. A lobby effort is also underway, though there is some concern that Dutch companies may relocate to areas with more accommodating legislation if EU policies do not change in the near future.

Table 2 presents a summary of the legitimacy strategies being employed by entrepreneurs – in cooperation with other sector participants – to gain cognitive and sociopolitical legitimacy. The sector has mainly focused on organization, intraindustry and interindus try strategies up to this point, though interindustry agreement and cooperation are still major issues within the sector. The sector is in the process of developing and implementing institutional strategies.

6.2. Media analysis

A LexisNexis search of the term “insecten eten” in Dutch news sources from 2000–2015 resulted in 476 articles. Upon further analysis, 278 of these articles were related to insects as food and feed for human or livestock consumption (as opposed to prey for birds, bats, etc.). The search showed a marked rise in the number of articles over the years. In 2000, there were no articles, in 2004 there were 5, in 2006 there were 33, in 2010 there were 16, in 2013 there were 34, and in 2014 there were 59 articles.

This increase in public interest in edible insects in the Netherlands corresponds to the increase in global scientific interest. Van Huis (2015, p. 5) reports that a Web of Science search of “edible insects” yielded 10 results from 2000–2004, 18 from 2005–2009 and 65 from 2010 to 2014; the same search with Google Scholar yielded 265, 460 and 1010 results, respectively. ”The launch of the academic journal Insects as Food and Feed in 2015 provides further indication of scientific attention to and investment in the subject. In addition, according to an article retrieved from the ScienceDirect database in September 2015, the numbers 1, 3, and 7 most downloaded food and technology articles in the previous 90 days were about the use of insects in feed (“Most Downloaded,” 2015). In January 2016, the numbers were 1, 8, and 11 (“Most Downloaded,” 2016).

With regard to the placement of the articles about edible insects in the Dutch LexisNexis database, our findings revealed that 94.4% were from newspapers, 3.7% were from magazines, and 1.9% were from news agencies. Concerning the geographic distribution of the articles, 54.9% of the articles were in regional publications, 32.7% in national publications, and 11.7% in local publications. With regard to tone, 52.2% of the articles were positive in tone, 42.2% were neutral in tone, and 5.6% were negative in tone. The dominant frames were insects as food (32.3%), followed by public acceptance (11.6%), sustainability (7.0%), environmental improvement (5.5%), and feeding the global population (5.2%).

Taken together, the analysis of the newspaper articles showed an increase in articles about edible insects over time, revealed that the edible insects were most often discussed in the context of food, public acceptance, or sustainability, and found that the tone of the articles was positive or neutral. The developments in media coverage points to an increase in public knowledge about and awareness of edible insects as a possible solution to a societal problem. If “the media are one institutionally rich indicator of society-wide legitimacy” (Deephouse and

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Dutch edible insect sector strategies for legitimacy attainment.</th>
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<tbody>
<tr>
<td>Strategy level</td>
<td>Cognitive (develop knowledge)</td>
</tr>
<tr>
<td>Organizational</td>
<td>Behavioral “as if” the innovation is a solution to social, economic, and/or environmental problems</td>
</tr>
<tr>
<td>Intraindustry</td>
<td>Dominant Design – No agreement as to whether food, feed, pharma should be leading; no collective strategic communication plan</td>
</tr>
<tr>
<td>Interindustry</td>
<td>Interfirm linkages trade fairs, conferences, workshops</td>
</tr>
<tr>
<td>Institutional</td>
<td>Cooperation with universities and research institutes</td>
</tr>
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inter and are working on industry standards, but according to the interviews mobilization and collective action. Insect breeders have formed Venik legitimacy.

Fiol, 1994).

– climate.

food source gains legitimacy in a restrictive legislative and cultural environment.

insect sector as it seeks to gain a legal and social license to operate in the Netherlands and Europe. Applying the legitimacy strategy framework developed by Aldrich and Fiol (1994) and borrowing from the literature on European biotechnology and food innovation, we were able to increase our understanding of how a sector introducing a new food source gains legitimacy in a restrictive legislative and cultural climate.

The findings show that the Dutch edible insect sector is utilizing strategies to increase its cognitive and sociopolitical legitimacy in a social and legislative climate that is wary of new food technology. Although it is not unusual for legislation to trail public opinion (e.g., US environmental and poverty legislation in the 1970s), the delay in edible insect legislation may point to bigger issues within the EU in which the current governance systems are not compatible with the social needs and the organization’s sustainability and food security goals (De Schutter, 2014). Suchman (1995, p. 585) indicates that “frictions” among the legitimacies are “most likely to arise when larger social institutions either are poorly articulated with one another or are undergoing historical transitions.”

At an organizational level, the Dutch edible insect sector has gained legitimacy as entrepreneurs have convinced employees, investors, and state policymakers that their products are a solution to global, regional, and local problems concerning food security, the environment, and declining revenue in existing industries. They behave “as if” (Aldrich and Fiol, 1994, p. 651) the edible insect sector is already a fact, convincing others of its promise through television programs, conferences, and other meetings and events. They have gained sociopolitical legitimacy by framing the industry as a natural solution to social and environmental problems and a rational rather than radical innovation.

According to the research, there is still work to be done with regard to obtaining cognitive legitimacy at an intraindustry level. Based upon the interviews, the sector is a highly competitive environment, comprised of individual ventures (Aldrich and Fiol, 1994, p. 654) rather than a group of entrepreneurs working together. This competition is impeding agreement on a dominant design and industry standards. As Aldrich and Fiol indicate (p. 654), “Fiercely competitive individual strategies hamper a united collective front by an industry.” This collective front will be especially important in public communication about the sector’s activities to society, and in its pursuit of cognitive legitimacy.

Sociopolitical legitimacy is strengthened through intraindustry mobilization and collective action. Insect breeders have formed Venik and are working on industry standards, but according to the interviews there is some disagreement as to how effective Venik has been up to this point. Again, competition within the sector appears to be stifling the group’s effectiveness. When associations are cohesive, they carry more lobbying clout and their messages are more consistent (Aldrich and Fiol, 1994).

At an interindustry level, edible insect proponents are gaining cognitive legitimacy for the sector by cooperating and collaborating with other organizations outside the sector. Trade fairs, trade platforms, and conferences – for instance, IPIP, IIC, and InsectCentre – have spurred interfirm collaboration in the sector. If the plans for Insect Valley are realized, interfirm collaboration will increase significantly. The project will involve members of industry, educational institutions, civil society, and government, all working together to research edible insects and their possibilities.

The sector is currently working with educational institutions with regard to research and programs, signaling the beginning of institutional strategies to gain cognitive legitimacy. Curricula are not yet being jointly developed, but collaboration between industry and research facilities is increasing. Regarding endeavors to improve sociopolitical legitimacy at the institutional level, a lobby effort has been set up in the form of IPIFF which has emerged as the voice of the industry in Europe. However, IPIFF is still in its early stages of development and membership is limited.

As indicated above, the edible insect sector appears to be gaining legitimacy by employing legitimacy-seeking strategies. However, the sector still lacks the legitimacy necessary to produce and sell its products on a commercial scale in Europe for use in food, feed (with the exception of aquaculture), and pharmaceutical applications. Based upon the research conducted here, the legitimacy literature, and the literature on the biotechnology debate, the edible insect sector could further improve its legitimacy by taking the following actions: First, develop a common vision and standards and agree on a collective narrative. Part of this will involve communicating potential benefits (Siegrist, 2008; Van Dijk et al., 2015) and how potential risks are being mitigated (Cardello et al., 2007; Rollin et al., 2011). In addition, making the link to nature and/or focusing on naturalness may increase acceptance of new food innovations by the public (Siegrist, 2008). Dissemination of knowledge is critical to legitimacy (e.g., Aldrich and Fiol, 1994; Hannan et al., 1995), and communication that involves the public may be especially important in gaining acceptance for novel food and food technologies (Ronteltap et al., 2007). In the case of GM foods, “Knowledge has been categorized as a singular human attribute that noticeably enhances the likelihood” of acceptance (Costa-Font et al., 2008, p. 109). Communication will be essential in addressing consumer concerns related to neophobia and technological processes (Verbeke, 2015).

Second, increase collaboration with NGOs and other civil society and consumer interest groups, on a sector level. Consumer trust is key to public acceptance of novel food technology (Siegrist, 2008; Rollin et al., 2011), and thus working with trusted sources such as NGOs and consumer groups (Eurobarometer, 2010) may increase legitimacy with the public. Involving various stakeholders in the communication about the sector could also result in greater public trust in the sector (Van Dijk et al., 2015). Rollin et al. (2011) suggest identifying stakeholder groups and developing a different communication plan for each one.

Third, make transparency and accountability a priority. The public has become more involved in governance issues (Bingham et al., 2005; Bryson et al., 2014), and food safety and sustainability must be rigorously studied, measured, and standardized in cooperation with researchers, government, and civil society organizations (Fuchs et al., 2011). Transparency, accountability, and collaborative research could also serve to avoid “social amplification processes” that hindered the introduction of GM foods (Gaskell et al., 2000; Henson, 1995; Siegrist, 2008).

Fourth, convey urgency and benefits. When there is a sense of low urgency, the public, policymakers, and civil society may see no reason to support a new food technology (Van Dijk et al., 2015). We do not have a protein or food deficiency in Europe so framing the issue just in terms of a protein source will likely not suffice in gaining support and legitimacy for the sector. Benefits must be conveyed in terms that resonate with various stakeholders and also demonstrate a sense of urgency where there is one.

Finally, increase the focus on institutional strategies. Expand collaboration with research institutes to improve the diffusion of knowledge about and trust in the sector. Collaboration with educational facilities is taking place, but to date this has been limited to individual research projects and conference planning. Involvement on a sector level (e.g., Insect Valley) could result in an educational curriculum specialized in insect breeding and processing for applications we are already aware of as well as those yet to be discovered. However, sectors must be well-organized before educational facilities will allow them to influence curriculum (Aldrich and Fiol, 1994), and this is not yet the case with edible insect proponents. Although IPIFF speaks for the sector
in Brussels, its membership is still not representative of the European edible insect sector. A more collective effort may result in the establishment of an industry infrastructure – the development of “a competence pool of scientists and managers through training programs and informal information sharing” (Aldrich and Fiol, 1994, p. 662) – that could be critical to obtaining sociopolitical legitimacy at an institutional level.

This research does not suggest that all emerging food technologies will acquire legitimacy if organizations follow the framework presented here. Strategies may not be able to alter cultural predisposition or public perception, but they can tackle issues of trust, benefits, risk, safety, transparency, and accountability, for example. Novel food technologies face even greater obstacles than other industries given the social context of food (Ronteltap et al., 2007). We do not yet know if the Dutch insect sector will gain the legitimacy it needs to succeed. However, it is clear that if organizations do not address fundamental issues related to the acquisition of organizational, intraindustry, interstate, and institutional legitimacy based on the beliefs, morals, and values of their particular society or culture, they are certain to fail.

While we believe we achieved the aim of this study, there are some issues that might be addressed in future research. First, interviews with grocery retailers and NGOs would have been informative. The organizations that were contacted declined to be interviewed, however. Future studies might include a broader range of interview subjects. Second, an in-depth case study of one firm in the sector might provide a more detailed illustration of how organizations in emerging sectors implement specific strategies to gain legitimacy. Third, it would be useful to know whether the sequence of legitimation is industry-specific. For example, is the legitimacy sequence different for the food industry than the technology industry? Finally, an analysis of the relationship between ideas and institutions might shed light on the political, cultural, and institutional challenges that are invariably linked to food and feed initiatives.

The research on novel food and technology discussed above (e.g., Rollin et al., 2011; Ronteltap et al., 2007; Siegrist, 2008; Van Dijk et al., 2015) offers important insight into, among other things, the role of communication with the public in introducing new products or technologies. This study complements that research by indicating specifically how and at what levels collaboration and communication should take place among sector participants.

With regard to the broader policy implications of this study, we would argue – echoing Hermann (2009) – that a one-size-fits-all approach to novel food legislation may not be effective or desirable. There is little dispute from actors in the edible insect sector that safety and environmental concerns must be addressed and that collaboration among producers, the scientific community, government, and other stakeholders is necessary to achieve this. Yet there is some question within the EU as to where to place edible insects on the current legislative grid. Given demographic and environmental trends and the necessity of alternative protein sources, further clarification in the short-term concerning edible insects and legislative fit is needed.

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Appendix A

Background: the use of insects in food, feed, and pharma.

It is estimated that there are over 2000 edible insects worldwide (Jongema, 2015). The FAO reports that 2 billion people on the earth eat insects on a regular basis (Van Huis et al., 2013). Insects are high in nutritional value with regard to protein, fat, amino acids, and micronutrients (DeFoliart, 1992; Rumpold and Schlüter, 2013; Van Huis et al., 2013). The exoskeletons of many insects also contain chitin, a polysaccharide which shows promise for medical (Lee et al., 2008) and industrial applications (Newton et al., 2005). As promising as insects may be nutritionally, the general public in industrialized nations has not embraced entomophagy. However, recent studies have found that gradual acceptance of insects into Western diets may occur as a result of emphasizing and publicizing the similarities between crustaceans and insects; increasing the general public’s exposure to edible insects through experimental tasting; and preparation of insects according to popular tastes, textures, and appearances (Megido et al., 2014; Tan et al., 2015, 2016). Verbeke (2015) suggests that consumer readiness to substitute insects for meat may be positively influenced by negative media coverage about livestock production with regard to animal welfare, consumer health, and the environment; information about insects as a sustainable source of protein; and the framing of insect eating in a positive light. His findings further indicate that food neophobia (fear of trying new foods) and a lack of knowledge about the technological processes involved in insect rearing and production are among the greatest barriers to consumer readiness to substitute insects for meat in their diet.

The insects that currently appear to show the most potential for consumption and processing in the West are mealworms, black soldier flies, crickets, and grasshoppers. Oonincx and De Boer (2012) concluded that given land use and other factors, mealworms should be considered a sustainable alternative to milk, chicken, pork, or beef. Compared to chickens, pigs, and cattle, crickets are 2, 4, and 12 times more efficient at converting feed to meat (Van Huis, 2013). Advantages of the black soldier fly can include that it can be reared on waste streams, it is not considered a pest, it can replace soybean and converting feed to meat (Van Huis, 2013). Oonincx and De Boer (2012) concluded that given land use and other factors, mealworms should be considered a sustainable alternative to milk, chicken, pork, or beef. Compared to chickens, pigs, and cattle, crickets are 2, 4, and 12 times more efficient at converting feed to meat (Van Huis, 2013). Advantages of the black soldier fly can include that it can be reared on waste streams, it is not considered a pest, it can replace soybean and converting feed to meat (Van Huis, 2013).

Due to the potential of insects as food and feed, the sector is growing across the globe, with breeders and processing facilities in Africa, Asia, Australia, Europe, Latin America, and North America. Some of the major players in the global sector are AgriProtein (South Africa), Enterra (Canada), Enviroflight (US), Hermetia (Germany), and Ynsect (France). This list is not exhaustive, but it provides an indication of how international the sector has become. Additionally, processing companies, such as those producing cricket flour and snack products containing insect-derived ingredients – are also becoming more prevalent worldwide. Some of the more popular or well-known products include Chirps cricket flour chips by Six Foods, cricket flour bars by Exo, Crobar energy bars by Gathr, and snack bars by Chapul, to name a few. Insects are already consumed in Africa, Asia, and Latin America, but they are less common as a food source in the West. Some experts are predicting that the global edible insect market will be worth USD 522 million within the next decade (“Global Edible Insects,” 2016). Insects are already consumed as human food in Africa, Asia, and Latin America, but they are less common as a food source in the West (Van Huis et al., 2013). Given the social, environmental, and economic potential of an edible insect sector, the FAO has endorsed the development of an edible insect industry in its publications in 2010 and 2013 (FAO, 2010; Van Huis et al., 2013). The World Economic Forum (WEF) has also shown support for innovation in the sector. In August 2015, the WEF recognized Protix Biosystems, a Dutch company specialized in protein extraction from the black soldier fly, as a technology pioneer (Vanham, 2015). While innovation in the field is taking off, legislation in the EU concerning edible
insects remains cautious.

European and global industry organizations have also been organized. The International IPIFF was established in 2013. Members include Protix (Netherlands), Ynsect (France), Hermetia (Germany), Koppert (Netherlands), ProtiFarm (Netherlands), Jiminis (France), HiProMine (Poland), Micronutris (France), NextProtein, MealFood Europe, Andromeda, NextAlim, and Entomo Farm (France). (The IPIFF website also lists 24 associate members.) The purpose of establishing IPIFF was to professionalize the lobby effort at the European Union level.

The North American Edible Insect Coalition was recently established “to foster collaboration amongst stakeholders and create a consolidated voice to encourage the positive growth of insects as both feed and food” (www.edibleinsectcoalition.org). The ASEAN Food and Feed Insects Association (AFFIA) was established in 2016 to promote “entomoculture, entomopahgy and their related activities” (www.affia.org).

Appendix B

List of acronyms/initialisms.

<table>
<thead>
<tr>
<th>Acronym/Initialism</th>
<th>Description</th>
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<tbody>
<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EFSA</td>
<td>European Food Safety Authority</td>
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<td>ENFR</td>
<td>European Novel Food Regulation</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<tr>
<td>GM</td>
<td>genetically modified</td>
</tr>
<tr>
<td>GMO</td>
<td>genetically modified organism</td>
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<tr>
<td>IIC</td>
<td>International Insect Centre</td>
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<tr>
<td>IPIFF</td>
<td>International Platform on Insects as Food and Feed</td>
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<tr>
<td>IPIP</td>
<td>Insect Protein Innovation Platform</td>
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<tr>
<td>NGO</td>
<td>nongovernmental organization</td>
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<tr>
<td>SMEs</td>
<td>small and medium-sized enterprises</td>
</tr>
<tr>
<td>TNO</td>
<td>Nederlandse Organisatie voor toegepast natuur-wetenschappelijk Onderzoek (Dutch organization for scientific research)</td>
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<tr>
<td>Venik</td>
<td>Verenigde Nederlandse Insectenkwekers (Dutch association of insect breeders)</td>
</tr>
</tbody>
</table>

Appendix C

First-order codes (second-order code in parentheses*)

1. Amino acids (E)
2. Animal welfare (C)
3. Automation key (F)
4. Awareness through media (C)
5. Bulk production key (F)
6. Chitin (B)
7. CO₂ reduction (G)
8. Commodity (B)
9. Communication strategy (A)
10. Compliance/standards key (D)
11. Conversion (B)
12. Cooperation among breeders is key (A)
13. Cooperation with research institutes very important (A)
14. Employment (B)
15. Environmental improvement (G)
16. Feed leading (B)
17. Feeding global population (G)
18. First-mover status is important (B)
19. Food (B)
20. Fundamental research key (E)
21. Globalization pressures (G)
22. Health/Healthy Publicize (C)
23. Hygiene standards key (D)
24. Ick/yuck factor threat (C)
25. Image as threat (C)
26. Ingredient (B)
27. Innovation (E)
28. Investment as threat (lack of) (B)
29. Knowledge as advantage (B)
30. Knowledge sharing (E)
31. Knowledge/expertise center (B)
32. Lack of cooperation is potential threat (A)
33. Legislation as threat (D)
34. Lobby necessary (A)
35. Local-for-local important to consumers (G)
36. Low quality feed to high quality protein (G)
37. Mega-stall: learn from livestock sector (C)
38. Move to mass (F) production/industrial
39. Nature (G)
40. New revenue model (B)
41. Niche (B)
42. Nudging: first feed, then food (C)
43. Perceptions of consumers (C)
44. Pharmaceutical (B)
45. Positioning is a strategic issue (A)
46. Price/cost reduction key (F)
47. Professionalization of sector is a strategic issue (A)
48. Profit as a reason to breed insects (B)
49. Profit possible? (F)
50. Proof of quality/safety needed (D)
51. Public acceptance (C)
52. Raw material (B)
53. Retailers important to sector success (A)
54. Safety research (E)
55. Safety: no threats of disease is key (C)
56. Scaling up (F)
57. Solution to agro sector decline (B)
58. Solution to global protein shortage (G)
59. Soy/Fishmeal alternative (B)
60. Strategy development as sector is key (B)
61. Sustainability (G)
62. Transition process (G)
63. Transparency (G)
64. Transparency/trust (C)
65. Triple Helix (A)
66. Uses insects research (E)
67. Validation-proof (E)
68. Volumes (F)
69. Waste management (G)
70. Work together to build sector (A)

Second-order codes/categories (number of first order codes in this category in parentheses)

A. Cooperation (10)
B. Economic Opportunity (19)
C. Public Acceptance (11)
D. Research (4)
E. Regulation and Policy (7)
F. Scale of Production (7)
G. Sustainability (12)

*Note. Some of the first-order codes could be placed into one or more of the second-order categories. However, the coders aimed to determine which relationship between code and category was strongest based on the interviews.

References