

European novel food, patents and brokers of knowledge

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Abstract

Design/methodology/approach – A multiphase mixed-methods design was used to combine data as follows: Worldwide patents originating from Norwegian novel food pioneers 2004 – 2019, downloaded through the European Patent Office database. Application data and interviews were analysed together with substantial information on 88 patents.

Purpose – The purpose of this paper was to study how public regulation promotes or hinders openness in the food industry, specifically how European novel food regulation has affected external ties among novel food pioneers seen through patents and their inventors.

Findings – Firms use patenting and novel food applications as part of a wider intellectual property rights strategy to guard against unintended spillovers and to shape external collaboration. Examinations of patents indicate a pattern of selective partnership with research and development (R&D) providers.

Practical implications – Food industry actors can combine property rights strategies to maintain a pattern of openness and external collaboration. R&D providers should consider the food industry's flag-planting strategies by integrating these into contractual regulations.

Originality/value – Little is known earlier about how novel food pioneers collaborate with suppliers, research actors, governmental actors, distributors, and customers regarding new product development.

Keywords Novel food; Open innovation; Intellectual property rights; Appropriability; Patents

1. Introduction

Pioneers within the food industry have filed novel food dossiers the last 22 years and learned this instrument to get radical food products approved (Holle, 2018; Hyde, Hartley, & Millar, 2017; Ververis et al., 2020). Novel food regulations have forced actors in a traditional industry to work differently. Open interactions with research and development (R&D) suppliers involving considerations of intellectual property rights (IPR) appear to be common during novel food development, making future studies of novel food patents and litigations useful for understanding innovation in this segment of the industry (Grimsby, 2020). Novel food regulation has affected collaboration due to weak protection mechanisms and challenges for innovators in capturing sufficient value from their innovations (Holle, 2018), what is often referred to as appropriability regimes (Hurmelinna-Laukkanen & Puumalainen, 2007). It has been argued that regulations have reduced incentives for food companies to innovate, partly due to the ease with which imitators can commercialize ideas (Holle, 2018). This echoes challenges described in the early iterations of the Open Innovation (OI) framework (Chesbrough & Crowther, 2006; Teece, 1986; West, 2006).

The OI framework posits that companies that share ideas during new product development with external actors become better at innovation than if they had been less open. However, when companies open up in this way, they might weaken their ability to capture returns from innovative ideas and may become dependent on trustful relationships. These conflicting views with organizational openness and spillover

prevention has been called a ‘paradox of openness’ (Arora, Athreye, & Huang, 2016; Laursen & Salter, 2014).

Appropriability regimes and openness are established concepts for understanding complex innovation settings (Hurmelinna-Laukkanen & Puumalainen, 2007). The novel food context adds to this complexity through its regulation that is both an approval and a sign of novelty. This creates an empirical gap – we know very little about how food companies innovate in this environment – and there is a potential for more theoretical insights into openness and protection of innovation practices and results. This observation leads to the following research question: *How do novel food pioneers balance openness, collaboration, trust and protection of intellectual property under the new novel food regulations?*

The remainder of this paper is organized as follows: Section 2 presents OI theory and collaboration patterns used to understand new product development of European novel food. The open innovation framework and the concept of regimes of protection are discussed here. Section 3 presents the background of European novel food regulation and previous studies of novel food. Section 4 describes the use of mixed method where combinations of various data from 22 years of quantitative European novel food approvals are combined with qualitative data from 13 interviews leading to further mapping of 88 patents owned by 7 novel food pioneers. Findings are presented in section 5 followed by implications for theory and practice in the final section.

2. Innovation theory

This section discusses how the concept of openness can explain various forms of collaboration for research-intensive companies that develop radically new food products, including how sharing with trusted partners may be organised and how patents can be tools for openness. To benefit from openness, companies need specific expertise and skills, including legal skills. However, introducing lawyers into business meetings may be a sign of tension and mistrust, and nondisclosure agreements may prevent openness. The involvement of legal experts in OI processes may potentially be both functional and dysfunctional (Post & Post, 2018). Stages of new product development may induce different forms of collaboration and openness, leading to various combinations of protection strategies and build-up of absorptive capacity. Further, managerial attitudes to openness and appropriability are closely connected (Laursen & Salter, 2014). The relationship between OI and intellectual property rights (IPR) has received much attention, and patent data has been used in various ways to understand technological knowledge flow and patterns of OI within companies’ R&D. The following theoretical perspective on knowledge flows, forms of appropriability mechanisms and trust patterns, is helpful for interpreting the use of patents in development of radically new food products.

2.1. Collaboration and the open innovation (OI) perspective

OI research concepts have evolved over time and have increasingly become tied to other theoretical perspectives like the resource-based view and alliances/network perspectives (Randhawa, Wilden, & Hohberger, 2016). Historically, innovation researchers focused on internal industrial R&D and portrayed innovation as relatively closed processes with little external interaction. In the OI perspective, organizational boundaries are permeable rather than closed, and innovation is moved from a specific location to a relational system with external partners (Bogers & Jensen, 2017). OI practices are used in a wide range of industries, though high-tech industries like information technology and pharmaceuticals are most often associated with this practice (Miglietta, Battisti, & Campanella, 2017). Traditional and mature industries, such as the food industry, may also subscribe to the foundational OI statement: “*not*

all good ideas will come from inside the organization and not all good ideas created within the organization can be successfully marketed internally” (Chesbrough & Crowther, 2006).

Food represents a mature industry with low profit margins and a high R&D failure rate (Tsimiklis & Makatsoris, 2015), and it is believed that OI approval processes will benefit from outsourcing of R&D activities. Food innovation research has focused on clusters, networks and innovation brokers as facilitators of innovation activity, as well as outsourcing of R&D, implementation and establishment of alliances for food industry partners (Barham, Dabic, Daim, & Shifrer, 2020; Cillo, Rialti, Bertoldi, & Ciampi, 2019; Randhawa et al., 2016). In addition, new research streams put commitment based human resource practices on the agenda, where biotech and food industries collaborate (Obradović, Vlačić, & Dabić, 2021). As such the literature analyses both inter-firm and cross-sector partnerships.

For development of novel food, asymmetry (Stefan, 2018) is an obvious collaboration challenge. Collaboration often happens between dissimilar partners with contrasting organizational culture and interests, leading to unbalanced relations. In cases of cross-sector R&D collaboration, scientists are primarily motivated by publishing while commercial companies seek profit. High commitment with long term employment relations is found to contribute to trust and innovative climates. What OI brings to the conceptual table is a focus on how collaboration patterns are fundamentally tied to other strategic considerations of firms such as how they protect their knowledge and develop their business models.

National collaborations are found to be successfully under semi-formal and informal IPR regimes with contracts as the main structuring of partnerships, while formal regimes like patents explain international collaborations (Stefan & Bengtsson, 2016). Semi-formal regimes in this setting may be trade secrets and nondisclosure contracts associated with collaboration with both academic partners and companies. Stefan and Bengtsson (2017) found that semi-formal regimes like nondisclosure agreements were positive for performance in the idea phase, while patents at this early stage were negative. Further, it was found that openness depth in terms of collaboration with R&D organizations contributed more to innovation novelty than to innovation efficiency during these early phases of new product development. Informal collaboration with such R&D suppliers during later engineering phases was found to be positive. However, at these engineering stages, informal collaboration with suppliers was associated with lower novelty (Stefan & Bengtsson, 2017). These findings from manufacturing companies are relevant for interpreting findings from the European novel food case.

To access new knowledge and establish trust, companies will have to manage inbound and outbound information (Nestle, Täube, Heidenreich, & Bogers, 2018). Exchange of information may contribute to reduced information asymmetries in clusters (Nestle et al., 2018), but as negative for building trust if it is unbalanced. In inter-firm clusters, increasing involvement by cluster members combined with similarities in perspectives, as found when actors share the same background by training or social capital, provide trust as opinions and behaviours are more homogeneous within than between groups (Burt, 2004). Brokers of knowledge connected across groups are more familiar with alternative ways of thinking and behaving. “Brokerage across [what can be named] the structural holes between groups, provides a vision of options otherwise unseen” (Burt, 2004). These are the mechanism by which brokerage becomes social capital. This promotes strong organizational (and personal) ties as building blocks of mutual trust.

In this case study of novel food pioneers, with inventors having unique backgrounds, selected innovators may be seen as brokers of knowledge. The degree of prior trust when trading technology is highly variable for companies, and a high level of trust prior business dealings is found to increase the probability of transaction success especially when patents are absent (Jensen, Palangkaraya, & Webster,

2015). Further, there seems to be a pattern where companies in high trust countries produce high level of joint output such as co-owned patents (Innocenti, Capone, & Lazzeretti, 2020).

2.2. Appropriability

Appropriation refers to how companies are able – or not – to capture significant economic benefits from their innovations and/or R&D (Levin, Klevorick, Nelson, & Winter, 1987; Teece, 1986). How companies manage the tension between appropriation and R&D collaboration has received attention by many scholars and triggered important insights. Companies' ability to capture and protect value creation from competitors is seen as a fundamental element of their innovation strategy (Cohen & Levinthal, 1990).

In addition to IPR mechanisms for appropriating returns on innovation, the tacit nature of knowledge, lead time, labour legislation contracts and practical human resource management are aspects that help understand how firms seek to profit from their R&D and innovations (Hurmelinna-Laukkanen & Puumalainen, 2007). Codified and explicit knowledge needs to be protected, but also the tacit knowledge embodied in employees may need protection. Tacit knowledge moves between companies through key individuals challenging employment loyalty and general protection of such knowledge. Hurmelinna-Laukkanen and Puumalainen (2007) found little action from companies utilising tacitness when trying to build barriers against imitation.

There are tensions and challenges when companies combine openness, IPR and technological growth, and balancing such tensions can be demanding. In addition, there may be a friction between value co-creation (together with partners) and value capture. Sources of tensions between collaboration partners may be uncertainty, asymmetry, lack of resources, different cultures or appropriability limitations (Stefan, 2018). Further limitations for appropriability regimes will be the complexity of patents and the high cost of defending patents years ahead. Tensions can also vary based on whether partners are firms or research organizations.

IPR generally works well when legislative mechanisms protect R&D cooperation from imitation. This applies to some of the products being exposed to copying in the novel food regulations. On the other hand, contracts do not work sufficiently against imitation during R&D collaboration outside academia (Veer, Lorenz, & Blind, 2016). Contradicting common OI success stories, companies' increased engagement in R&D cooperation was found to be negative for new knowledge production (Veer et al., 2016). Non patenting companies, easy targets for copying, respond with reduced R&D collaboration (Lorenz & Veer, 2019). However, companies with patents exposed for being infringed, in the meaning of being misappropriated as intruded, reacted by collaborating more with R&D suppliers in following years (Lorenz & Veer, 2019). Further, patent infringement may trigger cross-licensing agreements, since cross-licensing agreements open the way for R&D collaboration (Hagedoorn, 1993); in this way, being infringed may result in more R&D collaboration. This collaboration does not have to be with the infringer in order to bargain on IPR licensing, a collaboration with any party in the field is likely to happen (Hagedoorn, 1993).

2.3. Patents and openness

The paradox of openness during collaboration is a term used to describe a situation where managers make themselves open to external actors, who may be competitors, while at the same time strive to protect their knowledge from being copied (Laursen & Salter, 2014). Still, there are patterns where trade-off between openness and patenting are solved differently by leading companies and followers

(Arora et al., 2016). Furthermore, there seems to be an increase in patenting for leaders compared to followers. Followers, with incremental innovations will benefit little from patenting, and it is believed that followers patent less because it makes them less attractive as an open partners (Arora et al., 2016). Open innovation processes may be controlled by appropriation mechanisms such as patents, establishing market lead time or keeping key technologies unavailable for competitors while gaining access to complimentary assets (Arora et al., 2016). Arguments from Laursen and Salter (2014) suggests that appropriability and openness can be combined to benefit from external innovative ideas. Patents and publications can be complimentary when publication-based scientific prestige increases the value of related patents (Gans, Murray, & Stern, 2017). Companies that are overly protective of their knowledge might miss opportunities to exchange knowledge with different actors in the innovation system.

Whether patents are more often based on open or closed innovation is under debate. Comai (2019) divides patents into three groups; 1) Intra-firm where only company employees are inventors, 2) Extra-firm where external individuals are inventors and 3) Inter-firm relationships with co-applicants and more than one company owning patents. The two last groups are defined as open innovation based patents and has been found to characterize one out of every four patents (Comai, 2019). However, Vanhaverbeke et al. (2014) argue that most patents developed by large companies can be linked to R&D projects, finding that half of companies' R&D projects can be categorised as OI projects (Du, Leten, & Vanhaverbeke, 2014; Vanhaverbeke, Du, Leten, & Aalders, 2014). This means that many patenting processes may at least be partly characterized by open innovation practices, and it is interesting to explore how this plays out within the emerging context of novel food.

This study addresses how the open governance seen in novel food regulation has affected openness during collaboration and appropriability mechanisms across stages in the innovation process among food companies entering this segment. Formal, semiformal and informal property right mechanisms seem to be mixed and balanced by these novel food pioneers which may be conceptualized as a paradox of disclosure.

3. Novel food in Europe

For a long time, food products were considered safe in Europe if they were regularly consumed elsewhere in the world. New rules were introduced in 1997, with more sophisticated methods in the assessment of toxicological and microbiological safety (EC, 1997). This triggered additional requirements for imported foods as well as for food that had not been consumed in Europe prior to 15th May 1997 (EC, 2015). These safety standards were the same for all foods on the market, regardless of origin. The Commission designed the regulations to protect EU's citizens against possible hazardous effects from unknown food and represents an open governance approach with transparency and accountability. These regulations have not yet been studied with respect to patenting and their effect on innovation, openness, and collaboration.

Two decades later, the European Commission published a critical impact assessment for the old novel food regulation and replaced it with new centralized guidelines aiming at more speed to market and better protection for applicants (SANCO, 2008). 523 companies applied for permission to sell copies of novel food approved products, named 'substantial equivalent product' by the European Commission, during the first 20 years of novel food in Europe, following the first 128 approved novel food products (Grimsby, 2020). The Commission has since 2018 maintained a so-called 'Union list' of all approved novel food products. This makes it possible for new actors to move such products to the market, and the current rules give imitators the same rights to commercialize products as novel food pioneers.

Figure 1 illustrates the two main regulations of novel food in Europe. During the first 20 years (EC, 1997), each EU member state was involved in the process, which delayed the approval period leading to an average of three years to authorise the first 128 products. Under this first regulation, notifications of ‘substantially equivalent’ products were needed before putting approved products on the market for other companies than the applicant. 523 substantially equivalent products, or novel food copies, were approved during this first 20 years. However, under the new regulation from 2018 (EC, 2015) dossiers are sent directly to the European Commission. In addition, this revised regulation gives a possible data protection with individual authorization for applicant companies for five years, otherwise a generic authorization is given. Notifications of substantially equivalent products are no longer needed, since approved novel food products now are placed on the union list. All authorisations are generic, and the union list serves as a reference for companies who wish to place an authorised novel food product on the market, unless data protection is requested by the applicant.

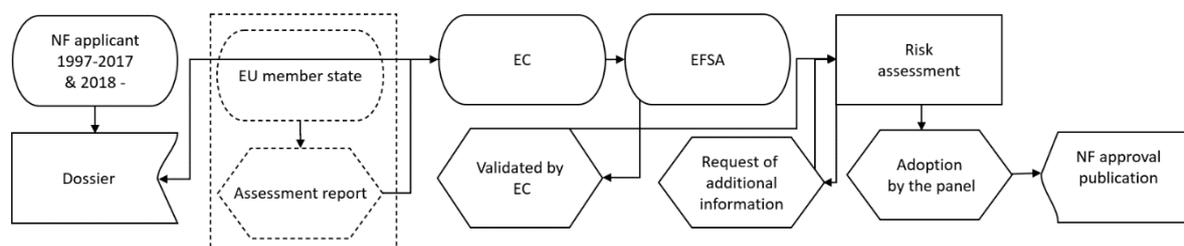


Figure 1: European novel food regulation illustrated in a fleet diagram. After 2018 novel food dossiers are sent directly to the European Commission and not passed through EU member states like during the first 20 years of novel food regulation in the EU. The box with the stippled line was included in the first 20 years of novel food regulation.

There are conflicting views on the EU novel food regulation; some have called it a regulatory failure, for example because it has slowed down the introduction of new protein sources through insect-based products (de-Magistris, Pascucci, & Mitsopoulos, 2015). In addition, EU food safety law has been considered as a negative integration instrument hindering free movement of goods since the requirement of scientific risk assessment for food safety sets limits for national legislators (Hermann, 2009). Production process are rarely approved as a novel process, but the final food product will have to be. For instance, in multiple cases of UV treated foods the vitamin D-enriched food component is regarded as novel, not the process. This is also the case of supercritical carbon dioxide for pasteurisation in liquids and solids (Smigic, Djekic, Tomic, Udovicki, & Rajkovic, 2019), leading to multiple applications with costly toxicology data for each product.

Finally, novel food may be associated with health claims. The European Commission authorises these health claims based on scientific evidence translated into labels possible to understand by consumers. The European Food Safety Authority (EFSA) is responsible for evaluating the scientific evidence supporting health claims. ‘EFSA approved health claims’ is referred to in the food industry, which puts considerable effort in order to meet these claims during new product development (Amanor-Boadu, 2004; Kinner et al., 2011).

4. Methodology

To answer the exploratory research questions of how novel food pioneers balance openness, collaboration and protection of intellectual property under the European regulations, a multiphase mixed method was chosen combining official novel food data with patent searches and interviews. Emphasis has been on transferability of results, starting from the general assumption that mixed methods can shed

new lights on phenomena rooted in disciplinary approaches. A pragmatist approach strives to integrate the subjectivity of own reflections and objectivity in data collection and analysis to probe into the research question and related sensemaking (Creswell, 2013; Shannon-Baker, 2016). Patents and forms of collaboration within selected actors among selected novel food applicants have been mapped to understand innovation processes. Previously investigations of the paradox of openness have mostly been conducted at the firm level (Arora et al., 2016); the approach in this article allows a better understanding also of the product and project level when novel food data is used.

The analysis started with mapping quantitative data from novel food approvals from 1997 throughout 2017, including descriptions of the project, initial assessment company, dates, company names, addresses and status of the application. These data were re-organized and processed in the database program Power BI and helped refine the research question and design the qualitative data collection. Further, interviews with selected Norwegian novel food pioneers were conducted. Norway had seven out of 128 novel food approvals and six of these companies were interviewed. This was complemented with interviews with seven novel food experts, giving 13 interviews in total. Database visualisation and patterns from novel food dossiers and notifications were presented during interviews for framing the case and directing the conversation. Patenting was mentioned by all novel food pioneer interviewees, and to follow up on this, the European Patent Office (EPO)'s database was used for downloading worldwide patents originating from the Norwegian novel food companies from 2004 to 2019. These patents were organized from database documents to spreadsheets and processed in the program Power BI. 249 lines with patent information including titles, numbers, dates, inventors, nations, owners, applicants, classifications and citations for the 88 patents were processed and re-written for sorting.

The number of patents held by these six companies, plus the one firm not willing to be interviewed, was 88. Publication date on these patents spanned from 2004 till 2019, with 65 inventors originating from 13 countries. How to protect knowledge and hinder competition from copied products was the main concern of the companies interviewed about patenting.

Parts of the first sets of data were used in an earlier paper focused on food policy influences on innovation collaboration (Grimsby, 2020). This paper, using a broader data set, focuses on intellectual property rights and how this interacts with regulatory aspects and company strategies. This allowed for a deeper understanding of the industry, its regulatory context and the associated appropriability regimes. The lead author's background from food research, combined with extensive work experience in adjacent industries, has been crucial for both access to interviewees and for interpretation of their statements. Notwithstanding, cognitive blind spots and biased interpretation could result from being too close to the material. A positive confirmation bias towards the favourable effects of collaboration patterns can be expected from OI researchers, while food research actors may have a negative bias towards bureaucratic centralized regulations. However, companies within the food industry applying for novel food approvals are rare, and little is known about these actors, which is positive for a balanced interpretation. Whenever possible, a third-party adviser has been consulted during interpretation of data. In addition, the four data sets using three methods to address the same topic, offers a way to triangulate, verify and validate findings. Due to the timeframe and lack of data, possible changes after the introduction of the new novel food regulation in 2018 have not been studied.

5. Results

The interviews provide indications on how public policy regulations and IPR instruments have affected external ties for innovation in the European novel food sector. All actors had patents and trademarks

registered, and the interviewees outlined clear appropriability strategies for protecting themselves against copying by followers. What we observe is a complex combination of different appropriability mechanisms (Hurmelinna-Laukkanen & Puumalainen, 2007). Our data does not allow for a comparison with non-novel food products and companies, but we observe that the novel food pioneers integrate novel food protection with other appropriability mechanisms.

5.1. Characteristics of collaboration patterns in the NF industry

The companies represented by the interviewees were all R&D intensive, which also meant that they had deep and long-lasting cross-sector collaboration with external R&D and innovation partners. Several interviewees discussed how their companies had long-term relationships with universities or research institutes, and that this was often particularly important in early stages as the novel food idea itself sometimes was introduced by such partners. In line with Stefan and Bengtsson (2017) academic R&D alliances were therefore described as central during early phases on new product development. *“The university here has been very important for us.... This company originated from the university, and it is still important for early phase research and similar. We have done lots and lots with several PhDs... [and] we even facilitated an industry financed PhD together”* (Novel food pioneer). Labour mobility and the build-up of tacit knowledge in PhD students thereby became an important appropriability mechanism, supported by specialised national arrangements for joint funding of such R&D.

Social network analyses of patents, their inventors and their employers also reveal multiple cross-sector connections between the Norwegian novel food actors, see figure 2. When looking at the background of these inventors and their patent collaboration, three research institutes and three universities emerge as having central roles in what may be termed a co-creation of R&D and innovative ideas. In line with literature on collaborative behaviour for company level appropriability strategies (Randhawa et al., 2016), partnerships and openness seem to foster innovation when scientists and novel food company employees pool their knowledge. According to interviewees, partnerships between companies and research organizations facilitate confluence of knowledge and provide a framework for developing knowledge towards innovations.

Building company value around patents combined with the novel food approval came up as deliberate strategies. Even if seen as important, protection of data when collaborating with public R&D organizations seemed to be fraught with uncertainty. Some interviewees expressed that IPR ownership during PhD support was too unclear, while others were more comfortable and trusting with early and deep R&D collaboration involving universities and educational institutions.

One novel food pioneer interviewee said, *“...we try to protect ourselves with patents and things like that,.. you are in a phase before you can patent things where you want to be sensitive... meaning protect sensitive information, and then you have problems with the universities about such things as ownership and data...”*. This quote illustrates how novel food pioneers, even one experienced with public R&D collaboration, sometimes expressed tensions between patent needs and publishing rights in partnerships with public R&D organisations. This finding is in line with previous findings of openness effect on companies' performance across stages in the innovation process (Stefan & Bengtsson, 2017). It may explain why some companies avoid involvement of external R&D providers during sensitive activities at early phases where patents might be developed.

Others expressed more confidence in patent regulation and practices and believed their IPR would be protected during cross-sector co-creation. *“...you can have the IPR, you will have to access it. Then there are at least two owners, the institution that produces the PhD and you as a business, owner and*

manager, you will get that knowledge” (Novel food expert). The shift towards an emphasis on commercialization and patenting for academic partners in Europe and Norway (Iversen, Gulbrandsen, & Klitkou, 2007) can contribute to these conflicts about independence, habitation and mixed roles for universities, research institutes and technology transfer offices. The establishment of third-party technology transfer offices running the patent work for universities and other R&D providers seemed to create trust between these novel food pioneers and the R&D providers.

5.2. Value of cross-sector collaboration

A surprising finding from the interviews was the importance ascribed to patenting and how patents were part of planned strategies in combination with novel food approval applications. The second most frequently used code from interviews, after R&D collaboration, included intellectual property rights and furthermore how protection mechanisms were combined with various forms of collaboration with providers of R&D. *“Behind this growth is our first patent, a synthetic patent. In addition, we have the novel food approval from 2012. These are the two most important foundations for our business in Europe”* (Novel food pioneer).

The main strategy in the first 20 years of novel food in Europe (EC, 1997), where notification applications were needed for second to market approaches, was to use patents as obstacles protection as well as for monitoring competing products entering the same market. *“So, we have our product patented, and if other companies file a substantial equivalent application, I would like to know about it. I don't think [that] someone has stolen our technology”* (Novel food pioneer). The new novel food regulation from 2018 (EC, 2015) introduced a possibility of data protection used by close to half of all new applicants. This protection will prevent new novel food approved products to enter the union list of the European Commission and thereby serve as an appropriation regime for 5 years. Novel food pioneers knew of this arrangement which was suggested by scholars a decade earlier (SANCO, 2008). Still, the data protection possibility differs from patenting since it relies on data being secret.

As illustrated in the social network analysis in figure 2, several inventors are engaged in patents owned by more than one company, and these can be seen as powerful brokers of knowledge (Burt, 2004; Innocenti et al., 2020). It also highlights an indirect form of inter-firm relations, which does not necessarily indicate direct collaboration. Appendix 1 shows the complete version of this plot including all inventors involved in the seven Norwegian novel food pioneers. Appendix 2 illustrates the same phenomenon with companies in the hub and inventors as plots on spokes. Four inventors have their names on competing companies' patents. Unlike tangible assets, knowledge is naturally mobile in the heads of individuals (Liebeskind, 1996). Even in a strict appropriability regime, there is a significant cross-organizational flow of knowledge. This flow of knowledge between inventors and the mobility of inventors might explain why the companies choose such complex combination of appropriability mechanisms. The clustering of competitors through inventions is indicated to be tied to a form of division of labour in patenting. In the words of one novel food pioneer: *“...we have focused on regulatory expertise, and we have focused on patents and gradually... those patents have covered production ... meaning we have no patents on machines, but we have on process and we have on use.”* (Novel food pioneer).

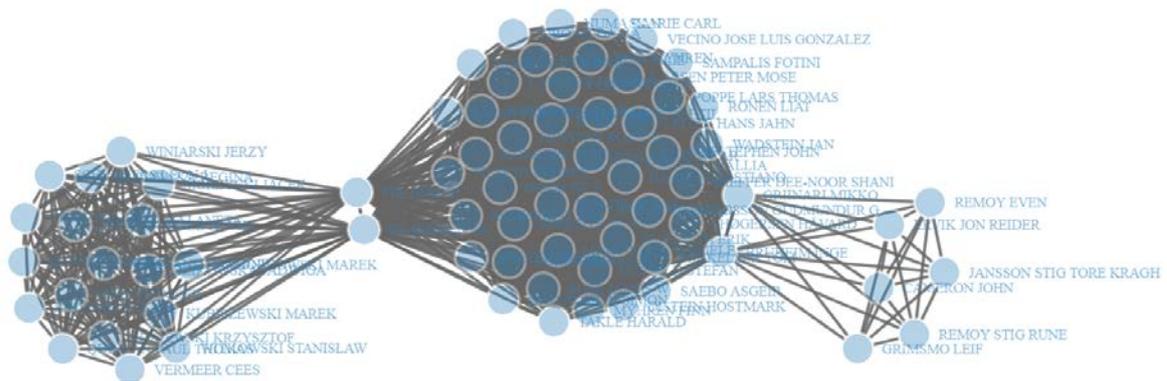


Figure 2: Novel food inventors. Network of patents clustered by inventors. Inventors of patents shape three companies, and four inventors are engaged in patents in more than one cluster/company.

5.3. Protection of intellectual property in competition contexts

Exchange of employees between the novel food companies is thereby indicated when patents have inventors that later end up working for competitors. Figure 2 illustrates this spillover and flow of knowledge with three competitors in the industry sharing four inventors. This finding is surprising; the seven selected companies only had two things in common in the beginning – they had filed a novel food dossier during the first 20 years of novel food regulation in Europe and they originated in Norway. This may serve to illustrate an unintended outbound flow of knowledge embedded in the heads of employees, though perhaps intended knowledge flow by the new employer. Although it was not a direct topic in the interviews, this finding indicates the importance of considering tacit knowledge and high labour mobility when considering appropriability mechanisms (Hurmelinna-Laukkanen & Puumalainen, 2007).

The lead actor in the marine oil industry controls more than half of the Norwegian novel food patents. This actor had taken over several international competitors. Two of the Norwegian novel food firms had met in court several times between 2017 and 2019 to settle patent-related lawsuits. This can be taken as another indication that the relationship between openness and patenting can be termed a ‘paradox’ (Arora et al., 2016). For the Norwegian novel food industry, it can be claimed that the largest actor trades off openness, perhaps because it is the only one with the power to do so. The pattern is nevertheless that the smaller actors seem to be more flexible with respect to strategies for openness towards external R&D, ingredient suppliers and users.

5.4. Balance between protection and collaboration

EFSA approved health claims came up as central for the novel food companies. Half of them had EFSA approved health claims and used these deliberately in marketing and sales. The rest were all working on getting health claims in Europe approved. However, getting health claims approval appeared to be more challenging than novel food approval, and regulation of claims seems to be handled differently in various parts of the world. Although health claims ideally should be easily understood by consumers to differentiate between products, EFSA approved health claims were also seen as appropriation mechanisms: “...if you don’t have protection, and others too have novel food but not the health claim, you end up competing on price only. And, then we have some (companies) that bear the whole burden of building the segment but do not gets paid for it...” (Novel food pioneer). As such we observe that the protection of intellectual property rights is tied to specific products including strategies and activities in marketing and sales, not just protection against spillovers to competitors.

Interviewed actors talked about the importance and challenges of publications. In the words of one novel food pioneer: *“We have a scientific paper. This was written in Canada based on the documentation we made, and it was ready for publication a year ago. But in fear of jeopardizing this (data) protection from the EU, right, we first seek the EU with five years protection, and then we will get there...”*. This quote illustrates how scientific publication, building up the credibility of findings concerning the new product, is part of a deliberate strategy. The strategy might in some cases imply to refrain from publishing to keep the results internally or use them purely for approvals: *“If you do not publish, but have the report on your desk, then you can choose to use the claim or case (for yourself) and not give it to anyone else”* (Novel food pioneer). Companies who did publish scientifically were conscious about timing in order not to reveal information that might preclude patenting.

6. Conclusions and implications

Patents, trademarks, EFSA approved health claims combined with novel food approval are central elements of appropriation regimes for the food industry actors. They are not just mechanisms for protection against copying but parts of wider strategies for building value into products. Based on selected literature on open innovation, appropriation regimes and collaboration, this study has scrutinized new product development under the novel food regulations in Europe. This represents a new context for the food industry and in practice a new category of products, and the study asked how novel food pioneers balance openness, collaboration and protection of intellectual property in this setting. Tensions between appropriating innovation return, exploiting external R&D and other resources and protecting internal intellectual property are key themes in the literature, often termed a paradox of openness.

The empirical work combines unique data from 22 years of European novel food dossiers with interviews and patent data, and it illustrates how innovation under the specific and open novel food regulatory system may amplify the paradox of openness (Arora et al., 2016; Laursen & Salter, 2014; Stefan & Bengtsson, 2017). Novel food pioneers collaborate intensely, which is in line with earlier findings and suggestions (Lyu, Zhu, Han, He, & Bao, 2020). At the same time, these companies have deliberate intellectual property protection strategies to limit unintended spillovers to potential competitors (Obradović et al., 2021), which is seen as a major risk of the open policy regulations.

Our study adds to earlier findings by providing nuances to how companies use a variety of protection mechanisms, not just to limit spillovers, but also in support of other activities related to the products like marketing. The high frequency of patenting is noticeable, and later investigations may want to focus more on litigation and lawsuits that our interviewees indicate are common.

Patent inventors commonly move between R&D providers and competing companies, as seen in Figure 2. This signifies co-creation with multiple actors engaged in innovation and knowledge development, and it shows how knowledge travels in less formalized ways between organizations. Surprisingly, competing companies rather frequently share patent inventors. This is illustrated further in Appendix 1 and 2 and may indicate both unintended knowledge flows and particularities of the absorptive capacity (Cohen & Levinthal, 1990) of the Norwegian novel food cluster. Furthermore, it may also illustrate human resource management challenges where embodied tacit knowledge is not protected during labour mobility (Hurmelinna-Laukkanen & Puumalainen, 2007), and may explain why the companies use such complex combinations of appropriability mechanisms.

We find linkages between companies and R&D providers as a clear indication of the open innovation practices of the novel food industry. ‘Open’ in this sense means that most companies carry out many different innovation practices together with external partners. But the partners are a select group of specialised R&D organisations and – indirectly through personnel mobility – some of their competitors. As such, the novel food companies are open but it might be relevant to view their larger innovation network as more exclusive and with public R&D organizations as intermediaries between the firms rather than direct inter-firm partnerships. Understanding differences in openness between organisational and industry levels is a promising avenue for further research, as is the intermediary role in complex processes of securing intellectual property rights.

Norway has six times more approved novel food applications than the average in Europe, and this case illustrates how the technological route can be used to understand knowledge flows (Linares, De Paulo, & Porto, 2019). In line with earlier findings (Du et al., 2014; Jensen et al., 2015), R&D collaboration between companies and academia is characterized by trust, which allows for dealing with the tensions of combining open publication with protection mechanisms (Gans et al., 2017), and may be a special feature of trust patterns in the Nordic region (Brockman, Khurana, & Zhong, 2018). We do find some nuances, especially with respect to the ability of the largest actor to ‘go it alone’ and choose a more aggressive patenting strategy.

Blends of formal and informal appropriability regimes follow similar patterns as found previously with a somewhat contradictory nature of disclosure and appropriation (Stefan, 2018). However, local R&D collaboration with semiformal protection mechanisms as nondisclosure agreements was not mentioned during interviews as much as informal trust mechanisms. In addition, knowledge sharing and collaboration towards trusted R&D academic partners follow patterns described in earlier empirical work (Arora et al., 2016; Laursen & Salter, 2014; Lorenz & Veer, 2019; Stefan & Bengtsson, 2017).

Finally, it has been found that novel food pioneers sell their products as pills and health improving shots more than as typical food products (Grimsby, 2020). This may put novel food actors into a subgroup of the food industry closer to nutraceuticals and medicine than food. This can explain why some of the intensive R&D collaboration and the importance of appropriability protection mechanisms seem more alike biotechnology and pharmaceuticals. This OI transition in food, biotechnology and pharma has been suggested as positive for developing more sustainable solutions (Obradović et al., 2021). However, for these novel food cases sustainability is not connected to cost of production or transportation but to new sources of food originating from microorganisms, fungi, algae, plants, modified molecular structures or animal parts (Ververis et al., 2020). Firms creating such products may be able to find highly specialised innovation partners that may help them manoeuvre in a complicated appropriability landscape.

A central implication for managers of novel food firms would be to establish links to R&D providers that can be trusted. Even if trust may develop accumulatively, experience with novel food regulations and a unit like a technology transfer office or other IPR-oriented unit are aspects that can increase the chances of fruitful collaboration. Firm size may influence collaboration strategy as well, where larger firms may have more selective open innovation strategies. In addition, retaining key employees, for example those who are patent inventors, could be an important aspect of protection strategies.

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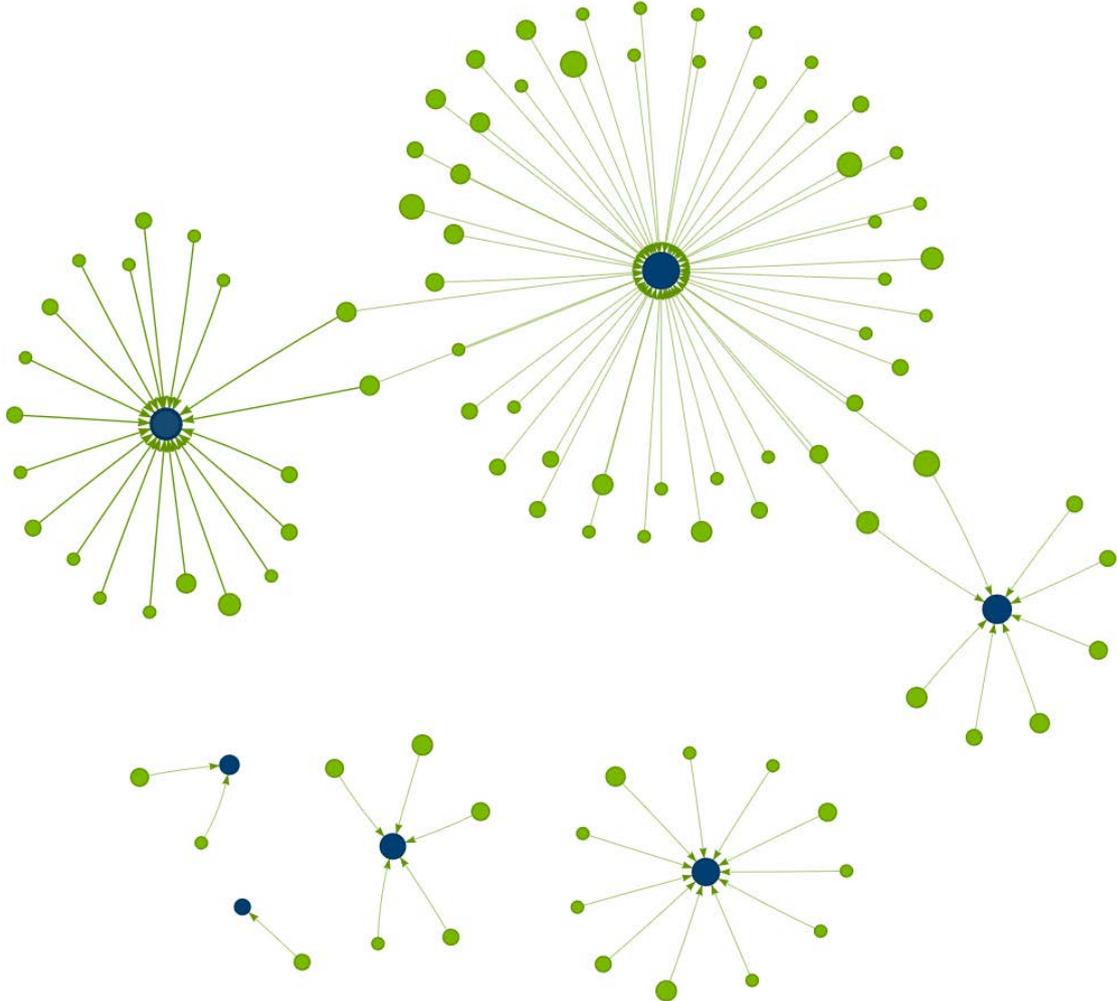
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Appendix 2



Network of patents clustered by the seven Norwegian novel food pioneering companies and their inventors. Structure of co patenting internally and externally. Companies in blue and inventors in green. Number of patents are illustrated as larger blue or green dots. Four inventors engaged in patents owned by more than one firm.