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Incumbents in the Transition Towards the Bioeconomy: The Role of Dynamic Capabilities and Innovation Strategies

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Abstract: This study explored incumbents' roles in the transition towards the bioeconomy by examining what goes on inside firms, what strategies they practiced, and how these affected the way incumbents engaged in the transition, as well as their ability to innovate. The study focused on the Norwegian meat-processing sector, investigating how dynamic capabilities affected incumbent firms in the transition process, and the management strategies adopted in response to external pressures (local and global) and to innovation opportunities. The analytical approach builds on two theoretical pillars: Multi-level perspective and dynamic capabilities. The findings showed that the incumbent exercised different modes of behavior—first-into-niche and follow-into-niche—in response to innovation pathways during the transition, mobilizing various dynamic capabilities—learning, financing, and organizational restructuring. The study sheds light on the underlying business dynamics of incumbent firms within a given regime and on intra-regime dynamics concerning innovation opportunities, and notes the proactive roles of incumbents in the sustainability transition.

Keywords: dynamic capabilities; incumbents; innovation strategies; multi-level perspective; sustainability transitions; meat by-products

1. Introduction

Incumbent firms can play an important role for the sustainability transition. The study of incumbent firms during transitions has received some scholarly attention. Nevertheless, several aspects remain unclear as studies do not address “what goes on inside firms”, which is another layer of complexity in transition research [1]. In particular, our understanding of what strategies firms adopt to shape sustainability transitions and what resources they mobilize and deploy to realize these strategies is limited [2]. To compensate this deficiency, transition scholars have begun to use management literature to understand firms' strategies and behaviors. However, despite the increasing focus and research on transitions relying on management literature for instance [3–5], little is known about how and why some incumbent firms manage to embark on the transition to a more sustainable economy, with others “missing the wave” and exactly how actors behave and why they do so has remained largely understudied [2,6–9]. Moreover, the mechanisms guiding and coordinating incumbent firms' responses to transitions are under-conceptualized [10,11].

To study incumbents' transition strategies, this paper employs the dynamic capabilities framework [12,13]. Although this framework has been used extensively in recent management research, empirical studies of dynamic capabilities remain under-explored in transition studies [14]. There is a paucity of empirical research that delves into “the detailed, micro mechanisms of how these capabilities are deployed, or how they ‘work’” [15]. Such a micro-approach might disclose concrete evidence of what dynamic capabilities look like in organizations and how context may affect them [15].

Most empirical studies on dynamic capabilities have focused on high-tech sectors (see Wang and Ahmed [16] for a comprehensive review), paying little attention to “low-tech” industries, like the food industry studied in this paper. The relationship between dynamic capabilities and sustainability has drawn great scholarly attention lately. Recent studies posit that sustainable innovation requires specific and new dynamic capabilities due to the complexity and uncertainty of new technological and market domains and regulations, see among others [17–24]. Nevertheless, our understanding of which dynamic capabilities are developed and how companies leverage and deploy these capabilities is currently insufficient [19,25].

Against this background, the study attempts to fill in such gaps by addressing the following research question: *How do incumbents’ dynamic capabilities affect the selection and adoption of innovative paths?* I seek a better understanding of incumbents’ roles in the transition towards the bioeconomy: What goes on inside firms, what strategies do they practice, and how does this affect the way they engage in the transition and ability to innovate. This empirical case study—the Norwegian meat-processing sector—explores the linkages between one incumbent’s dynamic capabilities and how it commits to the transition process (industry/sector transformation). I employ an analytical approach that builds on the multi-level perspective (MLP) framework of transition studies literature and the dynamic capabilities (DCs) of strategic management studies. The MLP is one of the main frameworks underpinning the understanding of existing systems’ transformative change—transition [26]. By incorporating the DCs framework into the MLP, the paper aims at exploring the underlying business dynamics of incumbent firms and understanding the intra-regime dynamics regarding innovation opportunities. The MLP could benefit from further insights into the role of incumbent actors in intra-regime dynamics of destabilization [27,28]. To the best of our knowledge, no efforts have been made in this regard, even though it has been noted that the MLP framework should be given more actor-related focus [29]. This could facilitate a better understanding of what is happening at the regime level [5].

The study applies a qualitative research design to gain a deeper understanding of the underlying processes of dynamic capabilities and incumbent firms’ innovation strategies in the Norwegian meat-processing sector by employing open-ended and semi-structured in-depth interviews, supplemented by informal and anecdotal observations. The empirical case—the meat-processing sector—is relevant for at least three reasons: (i) A rising global demand for food and food ingredients allows the food industry to examine all processing streams to add value, (ii) an increased demand for high-quality meat results in increasing volumes of meat by-products, and (iii) there is a large potential of these resources for high added-value applications in fields like biomedicine, food, beverages, cosmetics, etc. [30–33]. Moreover, food processing, especially mass meat processing, is closely related to the primary production system that is unsustainable in many aspects: A major cause of greenhouse gas emissions, land and water extraction and pollution, deforestation, and biodiversity loss, which falls in the middle of the current debate on climate change [34,35]. In particular, greenhouse gas emissions from raising cattle are the highest among other types of food sources [36,37]. Therefore, this necessitates a more sustainable processing practice and a need for resource efficiency—using the whole animal for human consumption and/or feed. However, the transition towards innovative by-products valorization pathways is proceeding slowly, partly because food companies realize lower margins than companies in other industries, and the raw materials involved are often vary highly [38], which in turn challenges the selection and adoption of innovative technologies.

This study contributes to the research strand on the transition towards the bioeconomy, see e.g., [39], by examining potential valorization pathways to increase the value of residues and by-products from food processing. In recent decades, the bioeconomy concept has been promoted in an attempt to deal with such major challenges as climate change, resource scarcity, and food security [40]. These challenges are not new, but they place a much stronger pressure on the world economy today. What is needed is a comprehensive approach that can promote innovation in a sustainable and integrated use of biological resources for the production of food, energy, and bio-based products [41]. This “bio-resource vision” of the bioeconomy focuses on processing and upgrading biological raw materials, as well as

on the formation of new value chains [42]. It embraces the concept of environmentally conscious economic growth, which calls for the efficient use of all bio-based resources with active engagement of all stakeholders throughout the economy. The bioeconomy vision is endorsed in the European Union's policy agenda as a knowledge-based bio-economy [43], where knowledge is closely linked with technological innovations to promote the sustainable, eco-efficient transformation of renewable biological resources into health, food, energy, and other high value-added industrial products. However, the bioeconomy concept involves different viewpoints and definitions, which has drawn much scholarly attention concerning the sustainability aspect [44–50]. While sustainability links closely to the bioeconomy, it is not an implied result of the bioeconomy. As De Besi and McCormick [45] maintain that even though the bioeconomy is based on renewable resources, it does not make it inherently sustainable. Therefore, Pfau, Hagens, Dankbaar and Smits [47] suggest that it is crucial that as the bioeconomy evolves, the relationship with sustainability is considered. More recently, the European Commission [51] encourages the integration of circular principles into the bioeconomy—a circular bioeconomy that integrates sustainability and circularity at its heart. The transition towards innovative by-product valorization pathways contributes to a wider sustainable bioeconomy transition addressing the need for better resource efficiency and bio-based value creation.

The remainder of the paper is organized as follows. Section 2 sets forward the theoretical framework. Section 3 describes the Norwegian meat-processing sector in the context of the bioeconomy and the incumbent under study. Section 4 outlines the methodological approach and the data used for its operationalization. Section 5 presents and discusses the findings and Section 6 notes the main contributions and implications of the study.

2. Setting the Theoretical Framework

The two theoretical pillars of the analytical approach are the multi-level perspective (MLP) (Section 2.1) and dynamic capabilities (DCs) (Section 2.2). The paper focuses on the regime level, as it accounts for the stability of an existing socio-technical system and its influential actors, the incumbents [7]. In Section 2.3, how these two theories can complement each other in dealing with a specific layer of complexity in transitions—what goes on inside firms—and how this contributes to exploring the challenges facing innovating incumbents is discussed.

2.1. The Multi-Level Perspective: A Snapshot of Incumbents in Transition

Multi-level perspective (hereafter MLP) delves into the analysis of socio-technical transitions and structural change in existing systems [27,52–54]. Basically, the MLP framework distinguishes three levels: Niche, regime, and landscape. Niches have been conceptualized as protected spaces, specific markets, or technological domains where radical innovations can develop without the selection pressures of the prevailing regime [55]. Regimes are the structured complex of more established practices and associated rules that stabilize existing systems [7], e.g., industrial networks, institutions, regulations, and user groups. Landscapes present a wider context such as demographical trends, political ideologies, societal values, and macro-economic patterns [7]. Transitions are produced by aligning trajectories within these levels, as well as between levels [56].

With the growing recognition of the need for a deeper understanding of the underlying business dynamics of incumbent firms within the sustainability context in MLP literature, increasing attention is being paid to the regime level and its core actors, the incumbents. Recent studies note various criticisms of regime conceptualization and how incumbents are portrayed. Three criticisms can be highlighted: (i) regimes are usually treated as black boxes, often interpreted as one stable highly aggregated structure [8,57,58], (ii) the lack of attention to the role of actors or agencies, especially in the regime concept [59,60], and (iii) incumbents are conceptualized mainly as locked-in and inert, “the old guards” [5] who are reluctant to new technological paths that may threaten their powerful position [28]. For example, Berlo et al.'s recent study indicates that incumbents in the German energy regime represent a major impediment to the transformation of energy supply by practicing conservation

strategies [61]. Hess [62] shows that political spending by incumbent industries overwhelms grassroots coalitions. However, other empirical evidence, see for instance [63,64], show that this is not always the case. Incumbents often engage on the basis of their resources, capabilities, and expectations, depending on the “timing and nature” of the transition [56]. Studying industry expectations regarding the transition toward a biobased economy, Vandermeulen et al. [65] observe a sequence of pathways starting with a transformation pathway and evolving towards a technological substitution or de- and realignment pathway. Furthermore, the behaviors of incumbent firms during transitions are subject to a common discontent with the current functioning of the system [66] and to shared expectations about the future regime [67]. Additionally, factors like exerted pressures may cause incumbents to display various modes of behavior during transitions.

These factors, however, are a partial explanation for the observed heterogeneity in incumbent behavior. van Mossel, van Rijnsoever and Hekkert [5] discuss four modes of incumbents’ behavior in relation to the niches: First-to-enter, follow-into, remain inert, and delay the transition. By being the first to enter a niche, incumbent firms initially further the transition. By following into existing niches, they wait for other actors to act as pioneers. Those that remain inert do not significantly change their behavior during a transition. Fourthly, in delaying the transition, incumbents employ strategies to slow down the pace of the transition or prevent it. Based on these theoretical inputs, the paper elucidates what types of behavior the incumbent exercises and what mechanisms lead to such behaviors.

2.2. Dynamic Capabilities for Sustainability

For a better understanding of incumbents’ behaviors and strategies in response to external pressures, this paper builds on the dynamic capabilities perspective (hereafter DCs). Teece, Pisano and Shuen [13] define dynamic capabilities as “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.” DCs are a source of sustained competitive advantage [13,16] as resource advantages may be insufficient, firms need to develop essential capabilities to make better use of their resources [68].

DCs are often seen as complex routines [13,69,70] where established technologies are often highly interwoven with user practices and life styles, business models, organizational structures, value chains, regulations, and institutional structure in existing sectors [9]. In other words, a firm is bound by its specific assets (e.g., physical resources, technologies, infrastructure, manpower, finance, reputation, etc.) and by its external environment [13]. These positions may bring in major challenges, obstructing firms from implementing changes, especially in the transition processes, which in turn requires firms to identify incisive strategies to respond to such challenges. Developing and investing in dynamic capabilities and new resources can play a crucial part.

To study how firms develop those essential capabilities, Teece [12] classifies DCs systemically into: *Sensing capability*, *seizing capability*, and *reconfiguring capability*. To simplify, the paper regards them as DCs’ processes. Sensing capability is the ability to learn and identify opportunities and threats such as consumer needs, technological possibilities, and competitor activity. Seizing capability is the ability to address and exploit sensed opportunities through new products, processes, or services. This process sets out the importance of facilitating necessary investments to realize the sensed possibilities in practice. Lastly, reconfiguring capability is to continuously align and realign assets and organizational structure, or to modernize routines, so as to sustain the business performance and growth.

For incumbents in the face of technological challenges and under sustainability challenges (as discussed in Section 2.1), identifying which innovations to develop is critical. These dynamic capabilities processes can be crucial in enabling them to develop innovation strategies [71,72]. Recent studies have proven the significant role of dynamic capabilities in developing sustainable innovations [17–24]. However, further research is needed to increase our understanding of how DCs are generated and how organizations utilize these capabilities [19,25]. Therefore, three capabilities—learning, financing, and organizational restructuring are explored alongside how they are mobilized along the three DCs’ processes. The capability of learning is a fundamental strategic issue, which allows firms to

identify new production opportunities [73]. A number of empirical studies have investigated firms' dynamic capabilities in several industries, e.g., mobile, automobile, oil, and gas, which lay stress on a firm's ability in acquiring external, new knowledge, assimilating it with existing, internal knowledge, and creating new knowledge, see among others [74–76]. Concerning the capability of financing, Lazonick and Prencipe [77] assert that financial commitment is one of the two important dynamic capabilities (together with strategic control), which are necessary conditions for innovative enterprises. Without the financial capability, innovative ideas are not likely to be developed. The capability of organizational restructuring refers to the ability that an organization reorganizes and restructures itself to meet its changing needs. This shows how it adapts to changes. Thus, these important capabilities deployed under the DCs' processes will likely affect how the organization develops its innovation strategies for sustainability transitions.

2.3. MLP–DCs Analytical Framework

The study focuses on the interlinkages between the dynamic capabilities of incumbents and how they commit to the transition process. An analytical approach that integrates the MLP and DCs frameworks is proposed, as complex problems are likely to benefit from insights obtained from different paradigms [13]. This approach (see Figure 1) aims to identify pressures by examining each level of MLP, mapping what goes on inside the incumbent firm such as the types of dynamic capabilities mobilized when external pressures are exerted and how the firm responds.

A socio-technical regime can seize the opportunities from the niche level only if structural change in the regime occurs [78]. Structural change at the regime level happens when there are linkages between multi-dimensional developments on the three levels of the MLP [78]. As to intra-regime dynamics, incumbent organizations are powerful actors that are able to influence much of the regime [79]. DCs allow an incumbent to adapt its (core) competences over time into a re-oriented strategy for addressing the challenges at hand. Thus, DCs concern an organization's ability to change structurally over time. Instead of outside-in pressure from the landscape level on the regime's environment, regime destabilization may result from pressure within the socio-technical regime itself. In a recent study on low-carbon transitions, Geels [80] propounds that incumbent actors can resist, delay, or derail transitions, but they can also accelerate them by reorienting their strategies and resources towards niche-innovations. Therefore, studies on regime-to-niche dynamics, including incumbent resistance or reorientation, are needed to complement the analysis of niche-to-regime dynamics (as in the niche empowerment literature). Fichter and Clausen show that established firms who possess market power can play an important role in the diffusion dynamics of a niche technology [81]. By striving for the dynamic capabilities complementarity, this study sheds light on the presence of intra-regime dynamics, which is recognized as essential for understanding incumbents' behaviors and regime (de)stabilization [6,26,28,82].

It is not easy for incumbents to undertake substantial changes in order to develop innovations because various processes keep them locked into the existing regime [83]. To change substantially, incumbents must find new ways of competing, by improving or building new capabilities. When an incumbent is confronted with massive challenges, incremental solutions are unlikely to suffice: Firms need to consider strategic re-orientation. Dynamic capabilities are believed to play an important role in such strategic re-orientation [84].

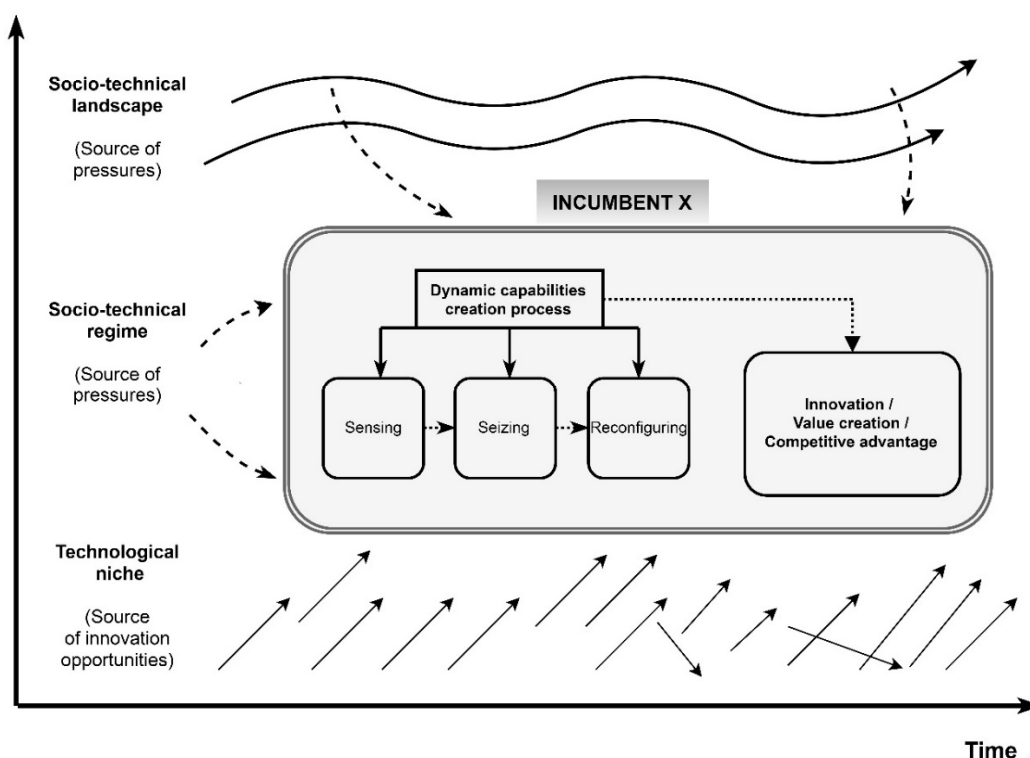


Figure 1. Analytical framework: The incumbent and dynamic capabilities (DCs) creation processes under the multi-level perspective (MLP) perspective, author's representation based on Geels [29] and Teece [12].

3. The Norwegian Meat-Processing Sector and the Case Study

Mass meat production entails mass meat-processing, which results in a large volume of animal by-products (ABPs) for handling. The potentiality of ABPs in various applications is widely recognized [32,85–87]. Herein lies a potential for identifying value chains within the food industry and across related industries regarding valorizing food wastes and by-product resources. However, current strict regulations on meat processing could possibly hamper this development if changes or new directives are not timely made by regulators [88].

The Norwegian food industry is the country's largest mainland manufacturing industry in revenues, value creation, and number of employees. In 2015, the industry had 2 100 companies with a total 48 995 employees and a turnover of NOK 214.5 billion (approximately USD 27.55 billion). A few big companies account for about half of the turnover and there are several small and medium-sized enterprises (SMEs). Within the Norwegian food industry, meat-processing is the biggest sector by employment (25%) and the second-largest sector by revenues (21%) (2016 statistics, in Prestegard, et al. [89]). Residues, wastes, and by-products from the meat-processing sector are currently processed and sold to specific markets such as pet food, biogas, composting, and feed ingredients. Statistics Norway's recent update in March 2019 shows that the Norwegian meat-processing increases in pig, cattle, and sheep production in the period from 2013–2018 [90]. In particular, cattle slaughtering has increased by almost 5% from 2017 to 2018.

The incumbent under study is a large meat and egg company, organized as a cooperative owned by approximately 18,700 Norwegian farmers. It holds a 70% market share with a turnover of NOK 23.2 billion (approximately USD 2.96 billion) and has 5179 employees in 28 municipalities throughout Norway. Animal by-products generated by the company (after the mainstream production process) include hides and skins, feathers, organs, fats, bones, blood, intestines, and internal parts, which estimates to 150,000 tons a year, or 35% of the total raw materials. The firm's strategies concerning rest raw materials are in line with the UN sustainability goals [91]: (i) Increase value by using the

whole animal for human consumption or feed, (ii) seek higher value-added markets for remaining raw materials according to a value-pyramid structure with top priority to human food, then animal feed, and last to biofuels or fertilizers, and (iii) assess various options regarding new processes and technologies for further increasing value.

4. Data and Methods

To implement this study, a qualitative research design was employed. In the first stage, 11 interviews in the period from 2016–2019 were conducted with managers and researchers of the firm engaged in the valorization process and other external actors, i.e., research institutes and rendering companies, who involved in the Norwegian meat-processing industry (see Table A1 in the Appendix A). The semi-structured and explorative interviews with the firm focused on the valorization of the by-product value-chain model: Main strategies, resources, technologies, markets, research networks, challenges, and environmental impact. Additionally, 3 extended interviews were conducted with one manager playing a key role in the firm's by-product valorization process. The interviews were carried out mostly on a face-to-face basis (only one of them were done via telephone) and lasted between 45–150 min. They were recorded, transcribed, and coded. Interview summaries were later written and sent back to the interviewees for double-checking to avoid misinterpretation.

In the second stage, artefacts, documents, reports, white papers (e.g., on industrial policy), and similar sources were collected, together with information on several research projects from a project bank of the Research Council of Norway (RCN) to complement and cross-check the interview data. RCN is a Norwegian government agency responsible for awarding grants for research and promoting research and science. To ensure triangulation of data sources, the views of additional actors were taken into account by interacting with representatives of the Norwegian meat-processing industry at seminars and workshops. On the basis of the empirical data collected, a case study of the company was conducted following the standard guidelines for qualitative research methods [92].

The choice of the single case-study method—a within-case analysis—is coherent with this aim: An in-depth understanding how and under what circumstances incumbents decide to engage in the transition towards a more sustainable industrial behavior. This approach fosters the delineation of the case's unique attributes and patterns, and may enable preliminary theoretical propositions.

5. Exploring the Case through the Lenses of the MLP–DCs Analytical Framework

The results of the analysis are presented as follows. Section 5.1 examines external pressures exerted at the MLP levels that triggered the incumbent to search for potential innovation opportunities in valorizing meat by-products. Section 5.2 scrutinizes how the incumbent organized its DCs to respond to those pressures and to implement changes. The findings are discussed in Section 5.3.

5.1. Unpacking the MLP Levels

5.1.1. The Socio-Technical Landscape

The socio-technical landscape level has been criticized for lacking clarity about contextual influences [93]. To address this, van Driel and Schot [93] present three types of landscape dynamics: (i) Rapid external shocks, such as economic crises and oil price fluctuations, (ii) long-term changes in a certain direction, such as societal values and trends, and demographical changes, and (iii) slowly changing factors, such as physical climate. Along these lines, two major events related to the landscape level and had considerable impact on the incumbent's by-product valorization strategy as emerged from the empirical analysis are discussed.

The first type of pressure is related to the first category noted by van Driel and Schot [93], referring to the import ban issued by Russia. On 6 August 2014, for geo-political reasons, Moscow issued a one-year decree prohibiting imports into the territory of the Russian Federation of certain agricultural products, raw materials, and foodstuffs originating from the USA, EU countries, Canada, Australia,

and Norway [94]. Products on the banned list included meat of bovine animals, pork, poultry meat and edible offal in all forms (fresh, chilled or frozen); sausages and similar products of meat, meat offal or blood, and the final food products based thereon. The embargo was later extended until 5 August 2016 and then further prolonged until 31 December 2019 [94].

The Russian ban changed significantly the configuration of the international raw materials markets. It changed the market. Specifically, when Russia closed its markets, a lot of products destined for human consumption that were intended to go from Europe to Russia had to find new markets. This led to an increased offer, so prices fell sharply. The international raw materials market is sensitive to political decisions. (Interviewee statement)

This event led to price fluctuations on the international raw materials market, which significantly impact the firm on its rest raw materials base. As the incumbent normally exported large quantities to Russia, it was forced to look elsewhere and to also search for valorization solutions.

The second type of pressure relates to the second category, pointing to a societal value regarding Norwegian consumer habits:

Maybe the main reason is that actually a lot of the rest raw materials are approved for human consumption, but nobody wants them. In Norway, we don't eat so much liver, tripe intestines, etc. We don't have a tradition, only eat the meat, while lots of other countries have a tradition in this respect and also a demand for those kinds of products. (Interviewee statement)

It may be reasonable to ask whether the incumbent could export more of its rest raw materials to other countries. However, that was deemed unprofitable, as it would entail additional packaging and transportation costs much higher than prices at which the rest raw materials could be sold. The incumbent had to seek out other solutions, in line with its strategy on sustainability aspects (Section 3).

5.1.2. The Socio-Technical Regime

Besides the pressures from the landscape level, those exerted at the regime level—the change in regulations concerning animal by-products in Norway and state funding—proved crucial in pushing the incumbent to explore new technological routes.

In particular, the change in Norwegian regulations concerning animal by-products in 2000 see [95], deeply influenced the firm's decision to look into the potential for valorizing animal by-products. This change imposed fees on slaughterhouses for delivering animal rest raw materials to rendering companies. As one interviewee explained:

There was a change in regulations many years ago [. . .] from one day to another, instead of getting paid for the rest raw materials, the slaughterhouses had to pay for delivering them to [a rendering company] [. . .] This was a big change because when you get paid for it, it is like ok, but when you have to pay, you see it as a cost, we have to do something about it.

Before this new regulation came into force, the slaughterhouses did not pay attention to the remaining raw materials, which were hurled into containers and taken to the rendering company. The quality of the rest raw materials was also unpredictable. The change in regulations brought strong pressures that made the incumbent shift its focus and discover what could be valuable resources. It started to take care of and handle its rest raw materials properly, while looking more assertively for new ideas and ways of valorizing by-products.

The second type of pressure concerns state funding. Its dimensions (availability/lack, constraints on grants, etc.) proved essential in supporting industrial firms and enabling them to embark on new research and innovation. As noted by one interviewee:

[. . .] I would say that Norwegian Research Council, the way they set up programs for research projects has been very well suited our needs or has helped us to move forward [. . .] if we hadn't got funding, maybe we wouldn't have worked with them, but we have been fortunate [. . .] in getting money from some of these programs.

The funding programs established by the Research Council of Norway (RCN) for supporting research projects proved functional and useful for industrial firms, like the incumbent in this study. By focusing on the sustainability criterion and putting in place an instrument like the BIONÆR program, the RCN made it possible for firms to consider and implement innovative ideas. The BIONÆR program aims at promoting research to raise the level, profitability and sustainability of production in bio-based industries by funding research projects. Setting the right framework conditions—state funding instruments—became a critical driver for firms to engage in by-product utilization.

5.1.3. The Technological Niche

Pressures at the technological niche level include the emergence of competing innovative pathways. Research advances (inter alia, medical and pharmaceutical, nutritional, novel foods, and ingredients) provide meat-processing firms with options for a wide range of applications [31,32,86,87,96], which are considered as a source of innovation opportunities. For example, extracted compounds, e.g., gelatin, proteins, collagen, and phosphates from by-products like organs, blood, bones, can be applied in food preparation, biotechnology, and chemical industry [33].

Technical methods, such as chemical precipitation, ultrafiltration, extrusion, lyophilization, isoelectric solubilization-precipitation, enzymatic hydrolysis, and solvent extraction, are widely employed in order to extract and concentrate proteins and peptides from raw materials [87,97]. Selecting one of these methods or a combination of them depends on the raw material type and the final application of the extract [87]. One interviewee acknowledged these potential applications:

There are lots of opportunities out there, for using new processes and technologies, [. . .] and we haven't exploited them all.

However, in order to employ or develop a given technology or technical solution, the incumbent had to take into account many factors, like the type of raw material and its volume, local conditions (specifically the geographical location of slaughterhouses where the remaining raw materials were generated), equipment cost, labor cost, expertise, research and development (R&D), etc. This links up with the strategic management dimension of the innovation process—dynamic capabilities—to which are turned to next.

5.2. *Untangling the Incumbent's Dynamic Capabilities Creation Processes*

Although the incumbent enjoys certain advantages in terms of resources, market share, market power and customer knowledge in comparison to other firms in the Norwegian meat-processing sector, it also faces numerous challenges. The valorization of rest raw materials is a new business area that is very different from its traditional focus on the main market for food primary products. This requires the firm to adopt new strategies and organize innovation processes differently. How does this firm intend to develop or employ capabilities, and use its internal resources in responding to external pressures like market changes/ uncertainties, changing regulations, and strict regulations on meat by-products? To answer this, three crucial capabilities—learning, financing, and organizational restructuring—which are related to its dynamic capability creation processes—sensing, seizing, and reconfiguring are scrutinized [12].

5.2.1. Sensing Process—The Capability of Learning

In response to the pressures exerted at various levels, the incumbent started “sensing” for viable technological options in developing innovative solutions to valorize its by-product resources. As it had limited human capital in that field, a crucial role was played by learning capabilities: Skill acquisition, knowledge, and accumulation of intangible assets [98].

Lacking in-house R&D capability on by-product valorization, the incumbent decided to go about acquiring knowledge by proactively participating in several research projects. Table 1 summarizes the incumbent's involvement in such research projects.

Table 1. Overview of the incumbent's research projects ¹.

Project	Time Frame	Type of Residues	Current Market	Window(s) of Opportunity	Innovative Path(s)	Targeted Market(s)
A	2012–2015	By-products derived from animal and marine industries	Low value products markets	Increase the knowledge base on enzymatic hydrolysis of animal and marine by-products	Developing rapid screening techniques for process monitoring of industrial enzymatic protein hydrolysis	New markets for utilization of animal and marine hydrolysates
B	2012–2018	Norwegian biomass derived from different industrial streams	NA	Establishing a national “enzyme development pipeline”	Developing competitive enzyme technologies able to utilize a wide range of Norwegian biomass	NA
C	2013–2017	Low value side-streams of Norwegian food industry	NA	Producing films based on products like polysaccharides (starch) from potato, gelatin, and protein from mammals and fish as well as chicken feathers	Developing biodegradable mulch films for weed control in row-crop production	Environmentally friendly substitute for herbicides, as well as for petroleum-based polymer mulch films
D	2013–2017	Chicken by-products (e.g., chicken bone cake)	NA	Addressing the potential obesity-reducing effects of bioactive compounds from meat on chicken bones and wings	Enzymatic breakdown of proteins Producing liquid or dried peptide hydrolysate with high quality and high value applications	Pet-feed markets Functional proteins/peptides for human products
E	2014–2017	Eggshell	NA	Converting eggshell membrane into raw material for biomedical applications	Biomedical process technology	Biomedical applications (e.g., new skin regeneration, wound healing)
F	2015–2019	By-products of food processing industry	NA	Developing new concepts and methods for flexible and sustainable food processing in Norway, capable of coping with the small volumes and high biological variation of existing raw materials	iProcess innovations e.g., 3D CAD anatomical models based on X-ray CT imaging and image processing; visual guidance of robot for adaptive processing, dedicated multifunctional and dexterous grippers challenging processing operation	NA

Table 1. Cont.

Project	Time Frame	Type of Residues	Current Market	Window(s) of Opportunity	Innovative Path(s)	Targeted Market(s)
G	2015–2023	By-products, residues not suitable for direct human consumption	NA	Developing sustainable feed ingredients from natural bioresources unsuited for direct human consumption	Innovative feed processing technology, conversion of national bioresources into feed for farm animals and fish	Novel feed ingredients
H	2016–2019	Plus products	NA	A new slaughter and cutting concept—improvement with the proposed processing method, based on pre-cutting of pig with warm cutting, form outside and in, and part-atomization		NA
I	2017–2019	12,000 tons of residues (plus products) from mechanical deboning of chicken	Cheap feed ingredients	Converting low-value plus products into high-value ingredients and foods for higher-paying markets	Enzymatic protein hydrolysis (EPH)	Sport/fitness market, and the elderly market
J	2017–2020	Poultry (chicken carcasses before and after mechanical de-boning) and dairy processing by-products	NA	Screening protein hydrolysate from poultry and dairy processing by-products for potential antidiabetic peptides	Antidiabetic peptides in protein hydrolysates	Medical applications

¹ Data collected in 2016–2017 from the Research Council of Norway's project bank; NA = no information available.

In contrast to the case studies conducted by Hansen and Winther [99], which indicate low levels of external collaboration, the firm under study collaborated actively with external partners in order to acquire the knowledge it lacked. As the valorization of organic by-products was a new area, and prior knowledge was limited, collaborating with knowledgeable actors in various research projects proved pivotal in enabling the incumbent to develop its knowledge base and explore various technological solutions for by-product utilization.

As shown in Table 1, along with knowledge-based development, the incumbent “sensed” a great potential for innovative paths based on enzymatic protein hydrolysates with various applications. For example, through the collaboration with research institutes in Project D and Project I, the incumbent focused exclusively on investigating enzymatic hydrolysis technology by using chicken by-products. It studied different enzymes and saw the potential of deriving functional peptides and proteins from this type of meat by-products. The results and knowledge gained from those projects was crucial for the firm to decide its next step. It also explored possibilities in both domestic and international protein markets. In the Norwegian market, protein hydrolysates could be used in the production of feed and pet food. However, the incumbent also targeted higher value-added markets: Applications for human consumption. That was reason for collaborating with international partners to find new niche markets, e.g., the sport/nutrition drink market in the USA, which was keenly interested in protein hydrolysates. Apart from this innovative path, it focused on eggshell membrane valorization and related applications as investment costs were not high there.

5.2.2. Seizing Process—The Capability of Financing

Seizing capabilities proved important in relation to two innovation projects: Enzymatic hydrolysis and eggshell membrane. As viewed by Cohen and Levinthal [100], it is critical for firms to recognize the value of new, external information, absorb it, and apply it to commercial ends. Those abilities are noted as crucial innovative capabilities. After having sensed the potential markets and technological options, the incumbent had to decide which of them to “seize.” As one interviewee explained:

We can't put all our eggs into one basket. We need to prioritize what we think is most promising and profitable. [...] We must think in terms of investments [...] and prioritize what we believe in most. For any project, there must be a certain profitability and potential involved.

Implementing divergent change can be costly, so various resources may be mobilized to attract endorsement and support for such implementation [101]. Financial resources are a key element. During the investment decision-making process, financing capability often plays a vital role as new innovations frequently entail high risks (for instance, building a new plant and buying equipment are costly).

Concerning the enzymatic hydrolysis project, the investment costs were very high, so the incumbent's decision-making process was lengthy. This path was chosen because it also received financial support from Innovation Norway (a funding instrument of the Norwegian government) for implementation in practice and, importantly, because the incumbent succeeded in finding a partner to share the financial burdens and reduce the risks. By contrast, the decision on the eggshell membrane project was taken quite rapidly, as investment costs were not high. Moreover, the incumbent's partner had previously developed a patented technology for separating the membrane from the eggshell.

5.2.3. Reconfiguring Process—The Capability of Organizational Restructuring

Reconfiguration refers to the ability to discern the need to re-arrange the firm's assets structure and to accomplish the necessary internal and external transformation [102]. Organizational structure reconfiguration has been shown to be an important dynamic capability [103]. By reconfiguring their business units, firms can recombine their resources and adapt to environmental changes however, this requires a persistent observation of markets and technologies and a willingness to adopt the best practices [13].

The incumbent under study had R&D personnel chiefly in the mainstream production and lacked human capital in the valorization field. Hansen and Winther [99] note that shortage of labor with desired skills (intangible assets) may generate big challenges. This was also the case for the firm in question because the by-product valorization was a new business area. As one interviewee explained:

We are involved in many projects. And [the company] increases focus on both innovation and research, also on using the resources of rest raw materials to add value and to make a new industry out of this. [. . .] That's why we need more people.

By expanding the R&D team in the valorization department, the incumbent was able to explore more of the opportunities “out there.” It also decided to establish a new joint venture company with a partner for the enzymatic hydrolysis project.

5.3. Discussion

5.3.1. Incumbent's Innovation Strategies and Dynamic Capabilities

The analysis showed that the incumbent practiced several strategies regarding by-product valorization and diversifying into various niches [58]. Taking the two innovation pathways discussed in the previous sections, the study found that under the pressures exerted at various levels such as the Russian import ban at the landscape level, the change of regulation at the regime level, as well as acknowledging potential technological opportunities from the niche level (as with the enzymatic hydrolysis and the eggshell membrane), the firm exercised two modes of behavior with the first-into-niche and the follow-into-niche modes [5], as shown in Figure 2.

The biomedical device developed from the eggshell membrane was the first of its kind in medical devices in Norway: The incumbent became “first-into-the-niche” by collaborating and providing the membrane for its partner. By contrast, the enzymatic hydrolysis technology had been previously developed by the Norwegian fish industry the incumbent learned, applied, and developed this further for the meat-processing industry by studying, using, and testing various enzymes in the hydrolysis process. In this case, the incumbent practiced the strategy of “following-into-the-niche.”

This study provides support to, *inter alia*, Steen and Weaver [58], by showing how the incumbent recognized the potential for leveraging its resources and capabilities to capture value in new niches. It also substantiates the argument put forward by Bergek, et al. [104]. Their study appraises incumbent firms' capabilities in acquiring and developing new technologies and resources, as well as integrating novel and existing knowledge into superior products and solutions (the “creative accumulation” process). This incumbent firm acquired new knowledge and technologies through sensing, seizing, and reconfiguring DCs processes, focusing specifically on the capabilities for learning, financing, and organizational restructuring. Thus, the study challenges the arguments of “competence-destroying” or “disruptive” innovations, according to which the extant knowledge base or business models of incumbent firms are made obsolete, leaving them vulnerable to the emergence of new entrants [105,106]. Furthermore, the paper does not provide evidence to support the common argument that incumbents tend to use their power to prevent changes that threaten their vested interests [107]. This study provided evidence of regime-to-niche dynamics and incumbents [80], whose strategies are to partake in the transition by entering and following into the niches, not delaying or derailing them.

The diversification strategy of the firm under study was evident in the way it used complementary capabilities, exercising various capabilities during the DCs creation processes, i.e., the capability of learning, financing, and organizational restructuring. Complementary capabilities may provide an incumbent firm with a competitive edge over challengers if it can build and leverage linkages between the innovation and the complementary capabilities needed to commercialize it, and if the incumbent is able to reconfigure in organizational form, structure, and preparedness for changes, formalizing continuous processes for seeking and exploiting business opportunities [108]. This will make it difficult for new entrants to acquire and access such complementary capabilities, thereby

enhancing “the likelihood of incumbent survival” in the face of technological changes [108]. Incumbents with strong dynamic capabilities are more likely to survive a transition than those without [5].

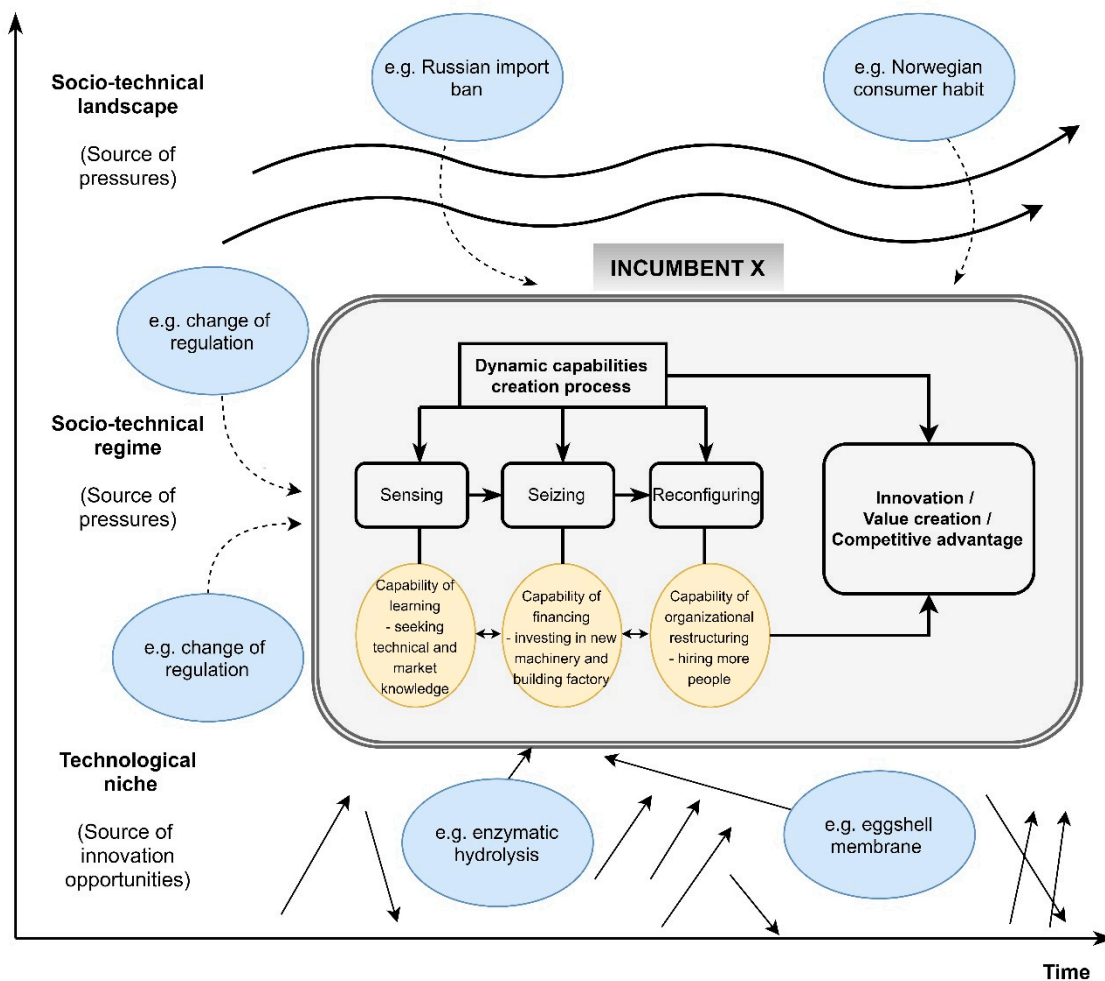


Figure 2. The incumbent and DCs creation processes under the MLP perspective. Author’s representation based on Geels [29] and Teece [12].

5.3.2. Leveraging Competitive Advantage

By mobilizing necessary dynamic capabilities, an organization can achieve new forms of competitive advantage given path dependencies and market positions [13,109,110]. The dynamic capabilities of the firm suggest that the performance and behavior of a particular firm may be hard to replicate even if its strategy and operation is observable [13]. The study supports this argument on the outcome of competitive advantage. By employing various DCs, the firm managed to achieve certain competitive advantages, putting into practice innovations to valorize its abundant by-product resources. The incumbent had had the same types of rest raw materials for years, if it had not exercised any forms of DCs it would not have been able to create new value out of its resource base. The empirical data shows that the two innovation pathways undertaken enabled the incumbent to market uptake. Moreover, it did not consider the by-products as a temporary advantage, but as a long-term strategy.

6. Conclusions

Arriving at a bioeconomy aimed at sustainability requires new governance efforts. The European Commission [41] has long recognized that valuable materials are disappearing from our economies and that there is economic and environmental benefit in making better utilization of such resources.

Moving towards a sustainable bioeconomy is essential to delivering resource efficiency and will require the involvement of all stakeholders throughout the economy.

Against this background, the contribution of this study was twofold. First, it provided a better understanding of Norwegian firms and their strategies concerning value creation regarding the by-product resource base, as well as how they organized their dynamic capabilities to achieve these strategies. It was shown how an incumbent firm in Norway, from a low-tech industry like the food sector, could take a proactive role in the transition process by creating new and/or higher value-added chains for their rest raw materials and by-products by instigating its dynamic capabilities. The incumbent's activeness was seen through a diligent search for new knowledge and inter-industry learning, making use of research network and public funding, and mobilizing its resources. Secondly, through the analytical framework employed and the within-case study analysis, this study added to the understanding of the types of dynamic capabilities mobilized by an incumbent when certain pressures were exerted at differing levels of MLP, as well as how they operated (singly or in combination), and whether these dynamic capabilities were effective [15]. In addition, the paper presented evidence of incumbents' regime-to-niche-dynamics by engaging in transitions. This aspect is particularly important: Despite the acknowledged economic and environmental potential of a bio-based economy, valorization of organic by-products is a new business area where incumbent firms generally have little prior experience or knowledge.

At the time of this study, it was not possible to assess the outcome of the incumbent's innovations on by-product valorization, as the firm was still in the stages of building the necessary infrastructure, and the end-products had not been launched on the market. This represents an opportunity for further research, so as to broaden the range of findings. For instance, future transition studies could assess the success rate of incumbent firms correlated with the adoption and/or development of dynamic capabilities during the transition process. Further empirical studies at the micro-level can help to provide a comprehensive understanding of firm behaviors and strategies during the transition towards a sustainable bioeconomy.

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Appendix A

Table A1. List of interviews.

	Date	Organization	Position	Duration	Type of Interview
1	12.02.2016	Incumbent	Business Development Manager	153 min	Personal interview
2	20.04.2016	Rendering industry	Product and Sales Manager	84 min	Phone interview
3	20.04.2016	Incumbent	Purchasing Manager	92 min	Personal interview
4	13.05.2016	Incumbent	Business Development Manager	57 min	Personal interview
5	11.07.2016	Research institute	Researcher	85 min	Personal interview
6	16.06.2017	Incumbent	Business Development Manager	112 min	Personal interview
7	15.03.2018	Industry Confederation	Managing Director	45 min	Personal interview
8	28.06.2018	Incumbent	Process and Analysis Manager	67 min	Personal interview
9	18.12.2018	Incumbent	Process and Analysis Manager	66 min	Personal interview
10	09.05.2019	Incumbent	Business Development Manager	50 min	Personal interview
11	09.05.2019	Incumbent	R&D senior scientist	50 min	Personal interview

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