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On Complexity, Ecosystems, and Sustainability in Local Food Supply: A Case Study on Fresh Seafood Supply

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ABSTRACT

The research question considers how local foods as networked food production may be studied from an ecosystem's perspective, being explicitly sensitive to process complexity. This implies integrating complex-process thinking with ecosystems thinking in cases of managing in local foods networks. First, the paper discusses what differentiates this form of food production based on features of interdependencies, information technology, traceability, and complex ecosystems. Supply chain management is expanded to conceptually model local food supply as complex ecosystems. The single case study provides a detailed description of the local foods network of a small Norwegian fresh seafood retailer and wholesaler. Findings include demonstrating the importance of complexity in achieving the sustainable production of local foods, and that this implies management following a paradoxical frame, as opposed to a business model frame. The conceptual model describes how food supply may be considered as an ecosystem mainly driven by economic concerns that are not in conflict with environmental and societal concerns. Since management in food chains is engulfed in a deterministic discourse on how to supply, the model also includes the role of paradoxical framing in managing networked food production operations. This model represents the basis for further investigation on local foods networks as complex ecosystems.

Keywords. Local foods network; Supply chains; Interdependencies; Complexity; Ecosystems; Fresh seafood.

1 Introduction

Through a detailed narrative based on a single case study, this paper seeks, to empirically demonstrate how local foods systems may conceptually be understood as an ecosystem from a supply chain management (SCM) business stance. Since the ecosystems approach is applied to consider the workings of food supply from a combination of business, natural environment, and societal viewpoints, this also implies considering how we understand sustainability in this context. The well-adopted and most often quoted definition of sustainability is that of the Brundtland Commission, later published by the World Commission on Environment and Development (WCED 1987, p. 43): "development that meets the needs of the present without compromising the ability of future generations to meet their needs". This study also considers the fruitfulness of applying an ecosystems approach to the supply problems encountered by local foods producers. The empirical part of this study describes in detail the supply chain of a fresh seafood retailer and distributor, Horsgaard & Co. AS, located in Western Norway.

Ecosystems thinking is a variation of systems thinking that focuses on ecology that makes conceptually explicit through modeling social and environmental factors in addition to the commonplace economic factors in SCM. Accordingly, "ecology" is a key aspect of an ecosystem, termed by Haeckel in 1866 as the science of relations between organisms and the surrounding outer world (Haeckel, 1866). "Systems thinking" implies a researcher making explicit – through the research agenda – an increased sensitivity to the complex interconnectivity of nature, society, and industry. This triad of concerns is often termed as "the triple bottom line". The triple bottom line has emerged as a paradigm for sustainable development, whereby meeting the needs of the present and future generations is classed under three dimensions: environmental, social, and economic (Dyllick and Hockerts, 2002), and in which the business models used by many organizations increasingly seek to include environmental aspects of performance, in line with the triple bottom line at a conceptual level (Birkin et al., 2009). However, evidence suggests that many organizations have taken a limited view of sustainability, with a narrow focus on environmentally orientated topics such as eco-efficiency (Dyllick and Hockerts, 2002; Cozens et al., 1999; Ball et al., 2006). While environmental issues are key aspects of sustainability, it is acknowledged that the economic and social dimensions need equal attention, though they are lacking in many corporate agendas (Sharma and Ruud, 2003; von-Geibler et al., 2006; Yongvanich and Gutherie, 2006; Diniz and Fabbe-Costes, 2007). An integrated approach to sustainability is important, since these three elements interact. For example, the effect of economic growth may increase an organization's carbon footprint and may also create employment opportunities for local communities (Kirchgeorg and Winn, 2006). In this setting, the role of business functions that facilitate interorganizational interaction – namely marketing and procurement – in driving forward the corporate sustainability agenda is critical (Green et al., 1996; Seuring, 2004).

Systems thinking is a core feature od SCM, and implies that the triple bottom line is viewed from a holistic perspective as an expression of the intertwined nature of these three parts. Underpinning the complexity of sustainability in a business context, Dyllick and Hockerts (2002) stated that "Corporate sustainability can accordingly be defined as meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc.), without compromising its ability to meet the needs of future stakeholders as well". This statement clearly includes societal factors when taking a business perspective; however, it still omits natural environment factors.

Ecosystems is a variant of systems thinking. A fundamental assumption is that the "system" is never equal to the sum of the parts of a meaningful whole. According to Broad (1925), the features of the system at a higher level of complexity will not be found at a lower level of complexity; structural patterns cannot explain the chaos of actual process interaction. Conceptually including process emergence (complexity) in systems thinking implies "opening" the system, unlocking the system borderlines, and considering functional change as well as multifunctional systems. The system may then better be termed a "network", and this open system is rendered a dynamic phenomenon. Expanding an open system thinking in SCM to encompass ecology involves expanding the core economic functionality of SCM. This expansion of SCM encompassing nature and society increases complexity due to an increase in the number of system agents, thereby also increasing the number of interaction points in the system. Nature is inherently both systemic and complex. As Capra and Luisi (2014, p. 68) stated, based on recent studies in many fields of natural sciences, "...nature does not show us any isolated building blocks, but rather appears as a complex web of relationships between the various parts of a unified whole".

Applying SCM as the foundation of this study implies focusing on management issues concerning how firms collaborate through the use of integrated resources in operations. These networked operations signify resource transformation, the production of value perceived by the customer. In a multi-tier supply network, the notion of "customer" is not straightforward, and there are layers organized through a long-linked supply chain of actors; a chain of sequentially interdependent intermediary "producers" that also play the role of being "customers". In addition, being sensitive to the emergent character of operations, customer value is a dynamic phenomenon; a moving target for the supplier as well as a product of the supplier–customer interaction.

In a study of short supply chains from a SCM perspective, Engelseth (2016) pointed out – based on empirical findings of a network of local foods suppliers to a common supermarket in Norway – that developing short supply chains involved in local foods supply is predominately associated with exchange problems, rather than with production problems. This means that economic considerations are not predominately associated with operations to transform the foods, but with how people interact in the network, thereby improving transactions in business relationships. This implies focusing on what Hammervoll (2014) discerned as the exchange economy, as opposed to a production economy focus.

Since exchange-dependent interactions involve pooled or reciprocal interdependencies that are typical of the service industry (Stabell and Fjeldstad, 1998), the logistics of local foods supply can be said to resemble that of "service supply chains" (Sampson and Froehle, 2006). This also implies that the development of local foods supply chains is associated with two paths that may be complementary. Accordingly, a view proposed by Engelseth (2016), rooted in contingency theory (Thompson, 1967), poses that local food systems are associated predominately with reciprocal interdependency. This view implies that developing improved intensive technology impacting on how people exchange information to mutually adjust production (operations) in the supply chain.

Another mode of local food chain development is that local foods suppliers may seek to reduce the fundamental reciprocal interdependency typical of such local foods networks. This involves increasing pooled interdependencies through enabling mediating technology. This technology form involves standardizing resources and thereby also creating more standardized patterns of interaction. Standardization may involve increased standardization of products, packaging, and labeling. This provides the grounds for investing in information systems including automated data capture and increase information connectivity in the local food supply chain by easing communication concerning both marketing and logistics (Engelseth et al., 2014).

This study builds upon a previous case study of a local foods supply network by Engelseth and Hogseth (2016), which was presented at the Igls Forum in 2016. Instead of taking the supermarket as the point of departure for investigation, the present study, based on a new and dedicated case study of Horsgaard & CO AS, expands the conceptual modeling to see how this supply chain may be viewed as an ecosystem. This company was one of the companies studied by Engelseth and Hogseth (2016). However, this company is the focal supply chain actor in the present study.

2 Literature review

SCM concerns actor integration in the supply chain to enhance collaboration, in order to more efficiently and effectively coordinate operations. This SCM stance is fundamental in this research, the developed frame of reference considers four issues associated with understanding local foods as sustainable production from what is provisionally termed as a "*complex ecosystems"* perspective:

1.1. Interdependencies and short supply chains
1.2. IT-enabled development in short food supply chains
1.3. Traceability systems and risk mitigation
1.4. Complexity and efficiency concerns in local foods ecosystems

These factors represent areas that have been previously focused on by research concerning SCM in local food supply chains. A limitation is that other topics may also be fruitful to consider. The aim of this review is to detect research gaps in these studies when considering these topics from an ecosystems perspective. These considerations funnel out into considering the topics of sustainability and ecosystems thinking in the context of local food supply chains.

2.1 Interdependencies and short supply chains

Interdependencies point out the role of power in the supply chain and how this power structure represents an organizing force in the supply chain. Engelseth (2016) discussed how this power structure in local food supply is fundamentally different from modernistic industrialized food production and distribution. The local foods producers are described as small and weak network actors. They need to focus on network navigation. Using the navigation metaphor implies that complexity is a core feature of local foods production. Processes are emergent. While the interdependencies in modernistic food supply are predominately sequential, involving long-linked technology, local foods production in short supply chains are characterized as involving predominately reciprocal interdependencies, and to a limited degree pooled interdependencies. This means that the state of interaction in the local foods networks predominantly involves interaction as *mutual adjustments*. Not only is interaction highly manual, the production is also characterized by a high degree of manual labor, here mainly concerning administration as labor. Therefore, in local foods supply, "….networking is the all-important supply chain activity to sustain local foods production" (ibid., p. 240). Thus, efficiency in local foods networks is tightly coupled with the effectiveness of mutual adjustment through dialogue with customers.

Since reciprocal interdependencies were the dominant form of interdependency in the study by Engelseth (2016), they represent the form of interaction that should be addressed when considering short-term development. Changing interdependencies is possible, but requires strategic planning and is a long-term endeavor. This also indicates that local foods production has much in common with many forms of reciprocally interdependent service supplies, which Stabell and Fjeldstad (1998) termed as "value shops". These local food supplies are mainly services, short in geographical structure due to the logistical proximity of the supply chain actors. In these types of reciprocally interdependent relationships, efficiency is associated with developing how agents manually interact; how do they do their sensemaking to decide on running operations? Alternatively, local foods producers may seek to reduce the reciprocal interdependency to become more in line with the "value network" ideal (Stabell and Fjeldstad, 1998). This development is founded on increased standardization of resources associated with interaction, information, goods, facilities, and tools. It involves both vertical and horizontal integration, containing integration through increased standardization of interactions with suppliers, customers, service suppliers (such as transporters), and other local foods suppliers (that may also be considered competitors). To the degree that reciprocal interdependencies still abide, the quality of manual interaction needs to be addressed. Rather than focusing on standardization using mediating technology (Thompson 1967), reciprocal interdependency in networks implies using intensive technology (Thompson 1967) to improve how people communicate, including support by IT. Two modes of developing interaction are pointed out. First, the development of mutual adjustment processes using intensive technology, and second, using mediating technology to better pool resources in the local foods network. Interdependencies reveal how integration should be carried out, through developing either pooled or reciprocal interdependencies. In these studies of interdependencies in local foods supply, the role of nature and society are considered only to a limited degree.

2.2 IT-enabled development in short food supply chains

Engelseth (2017) pointed out that the reasons for adapting information systems used in local food supply chains are divided into three dimensions: (1) Interactions in local food supply chains resemble service supply chains as a fundamental perception; and more operationally, (2) developing customer and supplier relationships through improving the use of intensive technology; and/or (3) economizing local food supply through developing the use of mediating technology. This line of argumentation is founded on the presupposition that local food suppliers do not pursue growth and instead aim to remain local food suppliers, thus aiming to develop the quality of their information systems and information use in this given short supply chain structure context.

Following Stabell and Fjeldstad (1998) on the strategic differentiation of service offerings, local food may initially be considered as either value networks (predominately reciprocally interdependent, applying mediating technology, standardized resources to integrate) or value shops (predominately pooled interdependent, using intensive technology to integrate). However, in actual business scenarios, the conceptual borderline between these service forms is rather pictured as a continuum. Engelseth (2017) suggested that, like services, local foods networks may be viewed as hybrids between these forms. Variation regarding interdependencies (Thompson, 1967) regards the degree to which local foods are considered either as "value shops" or as "value networks". This is dependent on the degree to which customer value is dependent on tailoring food supply. Following Engelseth (2016), local food supply may consequently not be analyzed using a long-linked technology framework, involving managing predominately sequentially interdependency, simply because such supply chains are short. This renders the deterministic paradigm of management involving “planning – implementation – control” of flows of goods. This SCM paradigm is unfit to develop food product quality in short chains typical of a local food supply.

Short supply chains are inherently transparent (Engelseth, 2016); that is, the customer is close at hand. Since local food production is highly market-contingent, the market context provides a “hand” that is visible to the local foods supplier, a reason for either developing or not developing the quality of personal interaction. IT may facilitate such mutual adjustments through negotiations, applying what Thompson (1967) termed as "intensive technology". Such forms of manual processes are very economically sound, especially when applied frequently and in large scale. Local foods supply is small-scale, and consequently involves a more limited amount of personal interaction than modernistic, large-scale industrial forms of food production. Relationships are easy to develop, facilitating intense interactions that may also be economically sound. Thus, coping with reciprocal interdependencies, as long as they are small, is no massive challenge; it is handled manually by enthusiastic local foods producers. Furthermore, to the degree that the quality of the foods offering is associated with personal interaction with customers, with the retailer intermediary or direct with consumers, IT should be developed to support this interaction. This involves developing information connectivity to support the role of the local food supply as a value shop.

However, local food suppliers who to a limited degree tailor their food offering to individual consumer preferences should develop pooled interdependencies. This is also the case as the networks – including an increasing number of customers – grow. The product uncertainty is low in such cases of standardized food production. There is a limit to how many agents in a supply network a local foods producer can seek mutual adjustments with, economically speaking. Strategically increasing the pooled interdependencies is more efficient in economic terms since it facilitates operations supported through IT use, based on increased standardization of processes. Therefore, they should strategically and operationally move from a value shop configuration to a value network configuration. This implies developing information connectivity to support the role of the local food producer as a value network by reducing the personal factor in the supply chain, increasingly automating it. This involves applying, what Thompson (1967) referred to as "mediating technology". Such electronic interconnectivity must be inexpensive to buy and easy to use (Engelseth et al., 2014).

Advancing IT competence is not prioritized by the local foods producers (Engelseth 2017). Therefore, cheap and simple IT-enabled connectivity solutions are advocated, such as programs provided by third-party suppliers to enhance traceability, tracking, and trading procedures. A study by Engelseth et al. (2014) showed how this is possible in a developing-country setting, using off-the-shelf standardized information system solutions. These systems should be easy to use, cheap, and preferably be usable on smartphones that actors already possess. These technologies should enhance pooled interdependencies, simplifying how goods are traded and communicated, while still providing a channel for mutual adjustment through intense interaction when needed. According to Engelseth (2017), "Local foods may, through improved information connectivity in their supply chains that support increasingly economical food supply, be moved from being a post-modernistic curiosity to become a functionally viable mode of geographically constrained mass food supply. If the practitioners and supporting forces understand their needs, in association with developing information connectivity, local foods may become the norm rather than the exception in the food industry". This implies that integration in local foods networks involves a combination of developing both intense and mediating technologies, and this development needs to be cost efficient. However, these studies show only to a limited degree how information systems communicate to and from society and nature. This implies widening the scope of information systems to encompass not only the workings within the supply chain, but also interconnectivity with society and nature.

2.3 Traceability systems and risk mitigation

Food product traceability is a SCM knowledge resource that importantly involves collaboration across the end-to-end supply chain (Engelseth, 2009). This competency is now demanded by governments in most developed economies in the world and in an increasing number of developing countries, especially since these types of economies export considerable amounts of foods to developing countries (Vanany et al., 2016). This traceability demand also includes the local foods producers. Food product traceability is not limited to legislative measures and implementing technical solutions to support this demand; it represents a form of interorganizational competence in the food industry that inherently demands an integrated and well-functioning collaboration chain to work (Engelseth, 2009). It is associated with "…the ability to trace the history, application, or location of an entity by means of recorded information" (ISO 8402, 1994). According to Stock and Lambert (2001), product tracing and goods tracking are activities that are combined to "…avoid litigation, firms must be able to recall potentially dangerous products from the marketplace as soon as problems are identified" (Ibid., p. 101). Product traceability helps to avoid repeating discrepancies in production. Similarly, tracing products provides information so that faulty products may be located and handled according to quality aims.

Quality of traceability is dependent on the quality the information flow concerning food product transformation in time, place, and form. This implies that information technicality is associated with registrations of food production, the product transformations in the supply chain. A tracing system in use helps to inform about production qualities, and this information about the history of foods in the supply chain may then be communicated from the place it originally was registered to the person demanding this information. Food product information regards technical registrations of product transformation in form, environments, location, movement, transactions, actors involved in product handling, and timing. Traceability is concerned with retrieving this type of information upon actual demand. This demand is more intermittent than continuous in nature (Engelseth, 2009). Continuity is represented by the traceability system in place in the network. Competence in food product traceability is ultimately measured by how accurate and timely information regarding product history is provided to actors in the supply chain who have made an explicit demand for this information (Engelseth, 2009).

While the technology to develop traceability systems is in place, the organizational willingness to follow up on IT-based potentials is not whole-heartedly followed up in food supply chains (Senneset et al., 2007). It is the organizing of food product traceability – including developing a supportive culture that is open to collaboration – in a complete supply chain that is most challenging, rather than understanding technical solutions. In local foods networks, given their small size and scope, developing and using traceability systems is an expression of *local collaboration*. This SCM-rooted development involves several actors, along with how they interrelate to technically integrate the way in which foods are traced and how this tracing functionality is improved. Along with representing supply-related activities that cross inter-firm borders, product traceability may be considered one such overall reason for supply chain integration (Engelseth, 2009). In local foods supply chains, Traceability involves competence associated with informing not only the present and future state of the foods supplied, but also with presenting its history. This is a way to create quality assurance that differentiates local foods from modernistic food supply

(Engelseth 2016). This also implies that a well-running traceability system mitigates risk. The risk is associated with the quality of the output, while traceability is associated with the quality of the information flow supporting this production flow.

Therefore, traceability may be used to mitigate risk. Risk management involves perceiving the future uncertainties of a business and dealing with these uncertainties today. According to Zsidin (2003), risk is the probability of an incident associated with inbound supply from individual supply failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to the consumer's life and safety. Risk assessment consists of identification, assessment, and evaluation; that is, risk can be measured. Different applied metrics and approaches account for risk management as phenomenon, taking into consideration the human perception and observable outcomes. Thus, “risk” is never straightforward, since “People's perceptions and attitudes are determined not only by the sort of unidimensional statistics used in tables, but also by the variety of quantitative and qualitative characteristics ...” (Slovic, 2000: 231). Traceability is a resource, since it helps to cope today with uncertainty about the future.

Developing food product traceability is a widespread practice that needs to be strategically organized (Vanany et al., 2015). Traceability encompasses risk mitigation, which creates organizational motivation to improve traceability in environments such as a local foods network. "While risk is associated with features of transformation in the supply chain, traceability concerns the potential for providing information about goods' transformation in the supply chain, that is, whether production is carried out in accordance with the food safety and quality requirements" (Parenreng et al., 2016, p. 2). Gonzales-Barron and Butler (2011), for instance, considered the use of meta-analytical tools in risk assessment of food safety, and it has become generally accepted that it is possible to apply the principles and methodologies developed for the risk assessment of toxicological substances to food allergens as contaminants (Crevel et al., 2014). Other publications have assessed risk by focusing on just one component of the food chain, such as production, postharvest processing, distribution, or consumption (Yeung and Yee, 2003; Lagerkvist et al., 2013).

These examples present risk management from a single-firm perspective. However, it is necessary to develop food product traceability through an integrated and coordinated multi-organizational effort, and to organize traceability systems from an end-to-end chain perspective. Parenreng et al. (2016) proposed simultaneous development of food product traceability with the mitigation of risk involving that these two types of developmental efforts are carried out at the same time. Vanany et al. (2015) described through a case study of mango supply for export how the case company intentionally integrated the monitoring of product quality with the development of the traceability function from a multi-tier supply chain perspective. Traceability is associated with mitigating the risk of low-quality food product supply; to avoid operational failures, the development of traceability to mitigate risk involves taking into consideration the fact that production is embedded in predominately reciprocal and pooled interdependencies. This implies that differently from modernistic, mass-produced foods, traceability follows a more flexible mode of production in cases of local foods production. Thus, the information flow that covers these flows of foods needs to be equally flexible; an adapted form of a local foods traceability scheme that is both inexpensive and flexible in use needs to be developed. Integrating to trace in the case of local foods is different than in mass-produced food chains. Traceability is an economic competence that secures sustainability; it is associated with documenting production of nature-originated foods and is a societal demand, and how foods are traced to secure production sustainability. In local foods networks, tracing takes place in a closer geographical setting, people and other resources being more closely located to each other. This should imply that developing a traceability-positive culture to implement electronic traceability should be simpler in local foods networks than in more modernistic food supply chains. Traceability, being a prime risk-mitigating resource, may be enhanced by expanding analysis in local food chains to consider risks associated with change in societal and natural environment factors more explicitly.

2.4 Complexity and efficiency concerns in local foods ecosystems

Complexity is primarily associated with emergence through processes. This implies that production is inherently associated with uncertainty, at least to some degree. This uncertainty may draw our understanding conceptually in diverse ways. Following Alderson's (1965) functionalistic view of distribution, the purpose of production is associated with inter-organizational structures where goods are sequentially transformed, providing time, place, and form utility through a series of intermittently directed transformations. This logic is typical for physical distribution, as is the case in food supply. According to Thompson (1967), this form of physical supply (not services) involves "long-linked technology". This technology is found especially in manufacturing industries, including modernistic food production. Following Alderson's (1965) transvection model of end-to-end marketing channels, production is described as piecemeal adjustments of pooled resources based on stepwise management of sequentially interdependent transformations of goods.

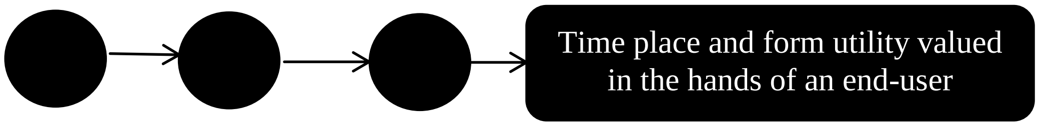

Figure 1. The transvection model. (Engelseth, 2017b)

The circles in the model indicate "sorts", which are decision-making events. This model may be described as a complex understanding of production, since the outcome flows of material are – in accordance with this view – multiple and sequentially interdependent, and may be understood as emergent. This evokes a notion of complex food production. The question emerges of to what degree this model, designed to explain how value is facilitated through production, may be adapted to smaller local foods supply chains. These short supply chains have already been discussed as more resembling service supply chains. However, management following the transvection model is local and information-based, located as it as at sensemaking in relation to "sorts"; that is, sensemaking events that create decisions on how to produce (food, in this case). According to Engelseth (2013), the managerial locus in the network when applying a transvection understanding of food supply is located at the "sorts", which as mentioned are short-term events that decide – based in information on the past, present, and future state of goods – how to send the goods effectively onwards to the consumer. Interactions between supply-chain agents mark the product flow as these agents collaborate operationally through exchanges in order to co-create value.

Since local food chains simply are shorter, like service supply chains (Sampson and Froehle, 2006) they are also expectedly more transparent than the long-linked ones: the horizon is smaller, and there are less people at this network outlook. Although production is emergent to the degree that the flow is locally managed by a coalition of complementary, environmentally contingent agents, this emergence is more visible in local foods networks simply because these networks have a simpler configuration. In relation to complexity as an organizational challenge, this implies that local foods chains have an organizational advantage in their clustering. This geographical and organizational smallness also generates a perception of network simplicity, rendering it easier for management to detect quality discrepancies. This also includes adjusting production to meet customer demands. It is fair to state that local foods supply is inherently quality-aware representing a more transparent organizational entity.

Using the transvection model, efficiency in local food supply can be described as reaping efficiencies of local decision-making in a context that is transparent, because this context is small and simple. This implies that integration is associated with sensemaking at sorts, and these sorts are fewer in local foods production than in modernistic food production. Following Weick (1995) and Weick et al. (2005), interdependencies experienced at sorts represent a form of sensemaking among the more or less integrated collective of networked local foods actors. This also implies that the “sensemaking” construct, rather than the more rational-grounded “decision-making”, is studied as grounds for managerial choice. Decision-making is the outcome. In a local food supply chain process, emergence is associated with changes in both production and customer value. Production and the perceptions of the end user are interactive. Since local food chains are shorter, they are seemingly more transparent. This complex nature of food supply should be easily manually detected by management. What then is the role of information technology in coping with complexity in local food supply chains?

2.5 Sustainability and ecosystems thinking in local food chains

From the perspective of the producer, producing local foods is predominately an economic challenge. Hutton (2001) defined economic sustainability as "the criteria by how a pound of profit is made in a building block in the creation of a just capitalism; progressive profitability must replace simple financial profitability as the sole yardstick of business success". This implies stretching economic concerns to encompass long-term thinking. Since human needs are core to this concept, it is also ethically laden, as it is associated with human wellbeing. The concept of "sustainability" is commonly associated with three interdependent dimensions (“the triple bottom line”), often termed as its pillars: (1) economic, (2) environmental, and (3) social (Meadows, 1972; WCED, 1987). These dimensions are hardly clear-cut, and being interdependent, they interact, which means there is room for interpretations of these dimensions as factors that may be conflicting. "Sustainability" may therefore be associated with power and interdependencies, as well as with power struggle and assumptions regarding trust. One of the fundamental potentials for conflict are conflicting interests between the present and future generations, often expressed as a conflict between the present-day older generation and the present-day younger generation. The main argument expressed here is that "network sustainability", which is the topic of this study and an inter-organizational aspect of corporate sustainability, is inherently challenging when taken as a management principle.

Developing local food production as an ecosystem faces a range of challenges in addition to that of simply considering the economic challenges. According to Engelseth (2015), there are three competing issues that explain why consumers buy locally produced foods: 1) food security and self-sufficiency, 2) protection of local markets, and 3) socio-cultural self-identification. This indicates a market awareness of the social and nature-related embeddedness of local foods production. Local foods production may easily be considered as a form of production in harmony with nature and with the parts of society that adhere to this as a societal value. This is also a source of market differentiation and competitive advantage. Taking an ecosystems view concerns regarding nature and society; it also expands network integration to encompass *ethics* and how this factor impacts the core economic concerns. As small-sized agents, local foods producers strive to survive in a volatile business environment. An ecosystems view expands this striving to survive to include equally taking into consideration, as a mental model of management, features of what Hahn and Figge (2011) saw as the key aspects of "sustainable development": (1) environmental integrity, (2) economic prosperity, and (3) social equity.

Multiple interdependent factors imply that the development of local foods networks is considered to be emergent, rather than subject to the more common planning paradigm found in business research – what Hahn et al. (2014) called a "business case frame" of sensemaking, as opposed to the more complexity-sensitive "paradoxical frame". The essence here is that the way in which businesspeople think of sustainability impacts sensemaking, and consequently decision-making. In this case, decision-making is found at a strategic level and is spread to a range of various networked actors thinking about how they should supply seafood from to their local markets. This focus on sensemaking is important, since the decision to develop local food systems should be considered subject to relatively intense interactions between varying mental models regarding supply functionality. The agents are diverse in this system (for example, food producers, logistics service providers, customers, and government). This also renders the SCM's ideal of integration as a non-straight-forward procedure.

Hahn et al. (2012) pointed out that achieving corporate sustainability involves coping with several dimensions of tensions. First, corporate sustainability involves perceptions found at the individual, organizational, and systemic levels. These perceptions may differ on the same factor at various levels. Second, sustainability also involves change. This need to alter patterns of activity represents a source of tension. Third, the context of corporate sustainability is also a source of tension. According to Hahn et al. (2012), context involves temporal and spatial considerations. The temporal aspect of sustainability is associated with the inclusion of long-term thinking, which may be a source of tension. The spatial element is associated with integrational equity, which is associated with where environmentally unsound practices are located. This aspect also involves those who are affected by, for instance, pollution, urban congestion, etc. These considerations of tensions associated with network sustainability also indicate that processes seeking to improve sustainability are embedded in a context of uncertainty. Thus, developing sustainability is complex in nature, a complexity that is perceived as parallel to daily operations. This factor increases as SM is explicit in regarding sustainability as a value and a managerial principle to be followed.

Developing local food supplies as an increasingly sustainable form of production is a process that does not follow a simplistic stage-wise development through planning, implementation, and control. It does not follow what Hahn et al. (2014) characterized as a business case frame. Practitioners may seek to simplify reality and force it into a simplistic business case frame. However, this mental straightjacket forcing increases the distance between the reality and the followed mental model. Hahn et al. (2014) proposed a paradoxical frame as more suitable for addressing the complexity associated with improving corporate sustainability, enabling countering research experiences with our pre-cognitions regarding features of environment, society, and the economic realm in this study. In this case we address the issue of developing network sustainability, and seek to merge these considerations with ecosystems thinking. This frame involves increased cognitive sensitivity to uncertainty and an increasing desire to explore and learn, as opposed to simplifying in order to understand and manage local food systems in a deterministic fashion, following a "planning-implementation-control" paradigm. A complex systems approach that encompasses the three factors of the triple bottom line model.

3 Method

This single case study involved a series of interviews and observations of Horsgaard & Co AS, a small, fresh seafood retailer and wholesaler located in the Norwegian coastal city of Molde (Engelseth and Sandvik, 2017). A single case means that findings may not be generalized from this study, which is also not the aim of the study. This study seeks to provide examples of local food supply practices that may be discussed in relation to the frame of reference created by the preceding literature review. A single case study, since it limits the empirical space, also provides greater detail in descriptions than multiple case studies. However, the possibility of case comparison is not present. Therefore, the value of a single case study lies in discussing empirical details found in the case such as processes and managerial conceptions.

This study followed abductive reasoning (Kováks and Spens, 2005) between ideas and empirical findings, using an iterative trial-and-error process to reach a new understanding of how ICT supports developing business processes in the context of a corporate merger in the food industry. Following Miles and Huberman (1994) and Yin (2013), the case study research strategy is used when: (1) making it possible to answer "how" and "why" research questions, (2) researchers cannot manipulate the behavior involved during the research process, and (3) researchers can seek a picture of the context in which the phenomenon is embedded. Taylor and Fearne (2003), Fernie and Thorpe (2007), and Holweg and Pil (2008) stated that the case method is appropriate for describing actors, network structure, and agency relations taking place through social interaction. A single case approach was applied, following Voss et al. (2002), to evoke micro-level details of the local foods chain. This involved designing a research process that led to "observations [that] generated new questions on which further interviews could be based" and eventually "added new dimensions to the subject, which eventually resulted in a new view of the phenomenon itself" (Dubois and Gadde, 2002). The case study was conducted in line with Yin (2008) to create focus and order as grounds for analysis in a complex, local foods network considered as a system. Case studies involve triangulation of methods (Thomas, 2011). In this case, the main strategy of data gathering was associated with carrying out semi-structured interviews, which means that interviews were sequentially interdependent and adapted to each new informant, building on knowledge derived from the preceding interview. In addition, research was facilitated by observations through visits to the focal local foods producer, a combined fresh seafood retailer and wholesaler and its network of suppliers and some customers. In line with Meredith (1998), we seek theoretical generalizability through discussing concepts at a higher level of abstraction. The single case study involved a mix of company visits followed by facility observations and telephone interviews of the local seafood supplier, its suppliers, logistics service providers, and two of its customers. This provided grounds for the following provided description of the local fresh seafood supply network.

4 Case narrative

4.1 Overview

Our case firm, Horsgaard & Co AS, had to decide to either compete or to cooperate with the larger food stores. The company decided to collaborate with the food stores and to become their supplier instead of struggling against them for market shares. This is the main reason why the company today has fewer employees than in its earlier, more independent years: today, there are only eight employees at Horsgaard & Co AS. Most of them are located in the fish shop in downtown Molde. Kjell Rune Kirkeland states that he emphasizes the quality of his employees: *"If you find a product in the fresh fish counter that you would not buy yourselves, it should be removed and not put on for sale".* This strict quality concern and aim is something their suppliers are very aware of, and in fact, they seldom receive from them products with poor quality. Their reputation of having excellent quality measures is also one of the reasons that Horsgaard & Co have managed to expand their business to places outside Molde and Romsdal in the last couple of years, expanding to places like Oppdal and Trondheim.

Figure 2. Horsgaard & Co's CEO, Kjell Rune Kirkeland, at the shop's fresh fish counter

4.2. Sales and supply

Wild-caught fish is particularly embedded in supply uncertainty. Therefore, past sales, seasons, and “gut feeling” based on many years of experience determine the volumes that are ordered each day. Horsgaard & Co AS follows a procedure of sending out frequent small purchase orders to its suppliers. The orders are sent to their suppliers early each day. At times when there is little fish to be obtained the same set of list of orders on products are sent to several suppliers, and the products are then picked up and delivered at night/early morning the next day. This means that Horsgaard & Co AS receives fresh produce each day. A couple of years ago, Horsgaard & Co AS tried to save on transportation costs by only ordering products every other day, but this created too much waste and a loss in profits. When Horsgaard & Co orders more than they can sell, they use the excess to create processed fish products, such as fishcakes, which they can then sell. This helps Horsgaard & Co AS to get rid of the waste from the fresh seafood sales in an economical fashion. This is quite important for a company of their scale. They produce several products at a small scale, instead of just discarding the product as waste, as larger companies commonly would, so that they can offer it to their customers. Most of the distribution of their products to their customers also takes place in a small-scale volume.

The major problem that the company experiences in their day-to-day operations is stated by Kjell Rune Kirkeland to be the availability and durability of the product. Fish as a product cannot always be obtained in the desired volume; this is mainly due to weather conditions. Because of the high frequency and small volumes in orders, Horsgaard & Co AS has a very quick responsiveness to uncertainties and changes that can occur in the demand of their products, and therefore the company does not face too big concerns and problems regarding this element. Regarding durability, the speed in handling the product before it is delivered to the customer is important to the company. As Horsgaard & Co AS competes, to some degree, against the large retail food chains (the ones they do not deliver products to), they place a lot of their attention in the quality of their products. Since their main product is fish or seafood, product freshness is very vital. Therefore, they have to be able to handle and deliver the products to customers quickly and more effectively than some of their competitors. In this regard, good supplier relations are a main competitive advantage.

Horsgaard & Co AS has four major customers: Coop Mega Molde, Coop Mega Oppdal, Eurest AS, and Eurospar Hjelseth. Coop Mega Molde is a grocery shop located in Molde’s city center and is one of Horsgaard & Cos’ oldest customers. The relationship between the two companies stretches back more than 30 years, dating back to 1985. Coop Mega Molde started using Horsgaard & Co As because of their close proximity, but has continued the relationship because of the high quality of their products and the great service provided. Coop Mega Molde orders their entire fresh fish assortment from Horsgaard & Co AS. They send their orders by mail to Horsgaard & Co AS every single day, although especially in the summer, some of the products are sold out. In such circumstances, it has happened that Coop Mega has sent out as much as three orders on the same day, using their own van. The orders are normally sent in the evening, and the products arrive on that same night. Eurospar Skjevik Hjelseth orders their entire fresh fish assortment from Horsgaard & Co AS, including shellfish and hand-processed fish products. They send out orders by mail in the morning one to two times per week, and receive the products early the next morning by transportation provided by Horsgaard & Co. When the products arrive, they are handled by Eurospar's employees according to set regulations and routines, and are put in the shop’s fresh fish counter. Located in Oppdal’s city center, about three hours away by car from Modle, Coop Mega Oppdal has been using Horsgaard & Co AS as their main supplier for fresh fish since 2013. When Coop Mega Oppdal became aware of Horsgaard & Co AS and the quality of their products, they were attracted to using Horsgaard & Co as their fresh seafood supplier. Oppdal is a major Norwegian winter resort town, and many of the customers there come from the large city of Trondheim, bringing with them food consumption preferences that include demand for quality fresh seafood. There was one major obstacle though, since the big chains normally follow a strict rule of purchasing in which the retailers are forced to use centralized purchasing agreements, even though small companies like Horsgaard & Co AS can provide substantially better quality at a lower price. They send orders by mail to Horsgaard & Co AS in the mornings, around 10:00 o clock, three times per week and receive the products on that same evening/night. When the products arrive with transportation from Shenker Molde, they are carefully handled by Coop Mega Oppdal's employees and put in the shop’s cooling room, where they are inspected and counted. Early the next morning the products are put out for sale in the shop’s fresh fish counter. Eurest AS is a part of the Compas Group and provides catering to different businesses and arrangements. When Eurest AS was selected to carry out the catering for Shell Nyhamna Ormen Lange located at Aukra, they decided to use Horsgaard as their fresh fish supplier. They started doing business with Horsgaard & Co in 2012 because of their quality and the level of service that Horsgaard & Co AS provides, and have since only had good experiences with the company; Horsgaard & Co's AS products have also become very popular with the workers and employees at Ormen Lange. Eurest AS orders fresh filet products, shrimp, and crab, and a normal order is around 100–200 kg. Eurest AS orders three deliveries per week (Monday, Wednesday, and Friday), and the order is sent by mail on Monday the week before. The products arrive at Ormen Lange between 10:00 and 12:00 and are then loaded off Horsgaard & Co.’s AS truck, taken out of the packaging, and put into Eurest AS’ own packaging and then stored for cooling. With the exception of Coop Mega Oppdal, Horsgaards & Co AS’ main customers are located near their local store location.

Horsgaard & Co AS receives orders by mail, and then sends an E-mail to check the availability of the product with their suppliers; they always call customers back to confirm what they can or in some cases cannot deliver (in these cases, Horsgaard & Co AS offers replacement products instead). Kjell Rune Kirkeland, the general manager, is responsible for the management of customer orders. He explains that he is always trying to formulate some sort of marketing questions that he can ask his customers, for example, concerning how they require the products to be packed. This enables them to get to know the customer and their demands for products. This also simplifies the work that Horsgaard & Co AS does to enable a customer-responsive supply. Customer relationships are expressed as vital resources in this effort.

Horsgaard & Co previously used channels like the local newspaper to inform customers about their products, with about 12–15 ads per year. Over the last couple of years, they have moved away from this type of advertising and now only advertise via Facebook, which also creates a dialogue with their customers. This dialogue – not only through Facebook and the Internet, but also face-to-face or by phone and e-mail – is very important to Horsgaard & Co, as a way of always trying to achieve customer satisfaction and being in touch with their customers, providing grounds for service development.

4.3. Sourcing and purchasing

The four main suppliers for Horsgaard are Vikenco AS, Strømsholm, O.Skarsbø, and Kongshaug Krabbe. O. Skarsbø AS is located in Harøysundet, Fræna and was established in 1919. Today the company is involved in fish and shellfish exports. The company started their relationship with Horsgaard & Co AS when the Kirkeland family became involved with the company in the late 1970s, and it has been a close and fruitful relationship ever since. The company delivers whole fish, filet options like pollock, haddock, monkfish, halibut, and plaice, and clipfish. The size of the orders placed by Horsgaard & Co can vary significantly, from 100 to 600kg. The orders are received in the morning, one to two times per week. After the O.Skarsbø AS receives the orders from Horsgaard & Co, they are put into the Maritech information system used by the company, where O.Sarsbø creates an order and check if they have what Horsgaard & Co wants, and then they send a confirmation back to Horsgaard & Co AS before the products are sent for packing. If O. Skarsbø doesn’t have the wanted products, or if they don’t have it in the wanted volume, they try to send it as soon as they have obtained it. Schenker Molde picks up the products between 16:00 and 18:00 each day and does the transportation of the products from Fræna to Molde.

Strømsholm Fiskeindustri supplies almost all types of fish filet, salted fish, and smoked fish. They normally deliver within the range of 100 to 700 kg, but a standard order is usually between 250 and 300 kg. Strømsholm receives orders from Horsgaard & Co AS every day, varying from one to ten orders each day. There is also considerable variation in terms of when the orders arrive, as this can vary from 08:00 in the morning to 02:00 at night. The orders are communicated by phone. This helps create a continuous quality dialogue between Horsgaard & Co AS and Strømsholm. After Strømsholm receives the order from Horsgaard & Co, the order is processed and registered in their system, and sent for packing. If Strømsholm in unable to deliver the product types that Horsgaard & Co AS specifically requires, they negotiate with Horsgaard & Co As by phone about the possibility to send different products instead. The products are picked up at Tustna by the transportation company, then brought and delivered in Molde at the Shenker terminal around 16:00 and 17:00 on the same day.

Vikenco AS provides seafood supplies from aquaculture, mainly salmon filet. The size of the orders they receive from Horsgaard & Co can vary from 50 to 500 kg and they normally receive the orders in the morning, four to five times per week. After Vikenco AS receives the order from Horsgaard & Co AS they use their Maritech information system to create an order, which is then checked up against what they have available. If Vikenco AS is not able to supply the product or volume, they call Horsgaard & Co AS and explain it. Normally these products can then be delivered on the following day. The products are picked up by Shenker and transported to Molde, where they arrive in the afternoon or evening of the same day.

Kongshaug Krabbe is engaged in the production and distribution of crab. It delivers such products as crab shell, crab claws, and cocked whole crab. They receive orders from Horsgaard & Co AS three times per week during season and one to two times per week during the winter, and the orders are normally received in the morning. When Kongshaug Krabbe receives an order from Horsgaard & Co AS, they write the order on a blackboard and after production ends, around mid-day, the products are sent to packing. The products are then picked up by Bring and transported to Molde and the Shenker terminal, where they arrive around 16:00 and 17:00 on that same day.

Horsgaard expresses that the quality of the product that they receive from their suppliers is "*alfa and omega*" and that they base most of their selection of suppliers on this fundamental criterion. The company operates with four main suppliers that are located near Molde. A good and strong relationship with their suppliers is important for Horsgaard & Co AS because of the frequently interactions that they have with them. Kjell Rune Kirkeland is also the person that is responsible for the interactions and handling of ordering merchandise from their suppliers, and he states that he always strives to create a dialog via telephone instead of just using e-mail with his suppliers, much in the same way as he does with his customers, so that the relationship becomes stronger and that the two parties can get to know each other better in terms of what products the supplier can deliver and what types of products and quantities Horsgaard & Co AS requires.

4.4. The logistics

Horsgaard & Co AS has centralized product arrivals by having all of products sent daily to only one terminal, Shenker Molde. For the products that are going to supermarkets and food stores that are located close to Molde, Horsgaard & Co transport the products themselves. In those cases, products are received from their logistics service provider, Shenker, early in the morning; Shenker then takes over the handling and delivering of the products, which normally is done at 07:00, 10:00, and 14:00. For products that are being dispatched to customers in the nearby region, like Kristiansund, Sunndal, the packed goods are delivered at the Shenker terminal, and Shenker and Bring carry out the transportation to customers. In the case of Oppdal and Trondheim, where transportation of products is done every second day, Horsgaard performs the handling and packaging of the product at the Shenker terminal and then Shenker takes over the transportation of the products.

Horsgaard & Co AS performs much of the transportation of their products to their customers. Shenker performs the transportation of the products from the Shenker terminal to Horsgaard & Co's location in Molde's city center. After the products arrive, Horsgaard & Co AS takes over the responsibility and handling of the products and loads them onto their own van. Horsgaard & Co AS operates one refrigerated van as their main transportation vehicle for the transportation and delivery of the products. Kjell Inge Kirkeland (father of today's CEO, Kjell Rune Kirkeland) is the person at Horsgaard & Co AS who is responsible for this van transportation.

Figure 3. Kjell Inge Kirkeland delivering products for Eurest AS at Ormen Lange

Horsgaard & Co AS states that a main reason for them to choose to perform much of their own transportation of products is to reduce costs and to personally interact with their customers. Having the same person showing up to customers and delivering the products each day is something that Horsgaard & Co sees as an asset that the bigger chains don't bother to utilize. The driver unloads the products and then takes the time, no more than a couple of minutes, to talk to the kitchen chefs to see if they received what they wanted. The driver is interested to see if they received their order in the wanted volume and so on, as well as to explain why they might not have received what they ordered or why Horsgaard & Co AS had to make some modifications to the order. Since Horsgaard & Co AS has chosen to perform most of the local transportation themselves, they also have the possibility to obtain a much greater degree of flexibility in terms of responsiveness to their customers, and this is a vital part in order to be able to create and obtain the level of service that Horsgaard & Co AS does its maximum to deliver. Instead of having to go through an external party, an operation that would have taken much more time and cost much more, Horsgaard & Co AS has the ability to respond much more quickly to unexpected changes in the demand from their customers. Kjell Inge Kirkeland explains that it has happened more than once that he has received a phone call from a customer that has been in dire need of products and in need of quick service. In these types of situations, Kjell Inge Kirkeland states that he always does his best to deliver and to help the customer, no matter the time of day. The transportation that Horsgaard & Co AS performs is normally done three times per day: at 07:00, 10:00, and 14:00, with transportation routes to customers that are located fairly close to Molde, like Coop Mega Molde, Eurest AS at Ormen Lange, and Eurospar Hjelseth.

Horsgaard & Co AS uses Shenker Molde as their main transportation partner to transport goods to customers that are not located near Molde (for example, in places such as Oppdal and Trondheim). They also use Bring, a competitor of Schenker, to perform the transportation of products to some of their smaller customers that are located in places like Åndalsnes, Finnøya, and Kristiansund. Shenker has contracts on two routes of transportation for Horsgaard & Co AS. The first of these routes is from the Shenker Molde terminal to Horsgaard & Co, where Shenker delivers the products that Horsgaard & Co AS can then transport themselves. This transportation is done daily at 05:45 in the morning. The second route where Shenker Molde provides the transportation for Horsgaard & Co AS is to Horsgaard & Co.'s AS customers in Oppdal and Trondheim. This transportation route is done three times per week. The logistics network of Horsgaard & Co AS is illustrated in Figure 4, indicating the main flows of goods:

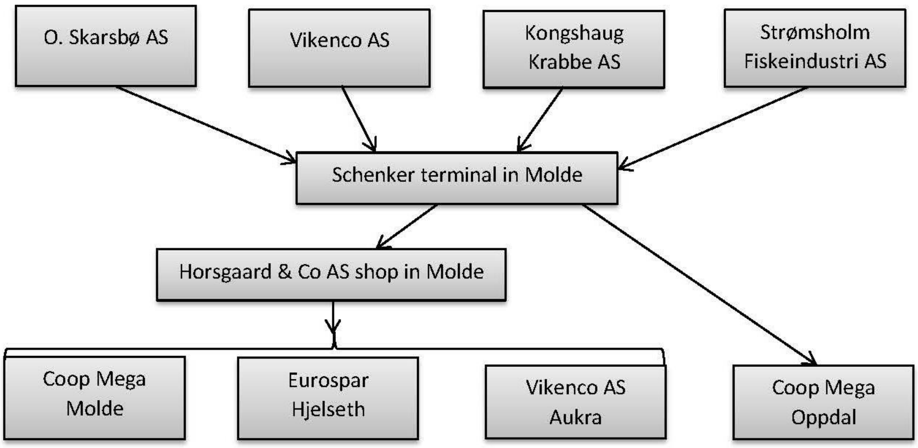

Figure 4. The logistics network of Horsgaard & Co AS

5 Discussion

The following discussion is structured in accordance with the analytical frame of reference provided in Section 2. This provides insights into the "as-is" state of Horsgaard & Co. AS's local foods network, as well as considerations associated with its development.

5.1. Interdependencies and short supply chains

Upstream in the supply chain, the suppliers are all relatively small firms. However, they have quite diverse types of seafood production, with differences in applied technology. The wild catch seafood is most vulnerable to variations. However, an aquaculture-based supplier also has limited flexibility, since their product cannot immediately be taken out of production for slaughter. From the perspective of Horsgaard & Co AS, these suppliers are complementary rather than competing. This means that the network is tightly coupled, limiting the possibility of switching suppliers. Although the interdependency is fundamentally sequential since this is physical distribution, supply is rather transparent, as the chains are short. Therefore, the planning problem is less related to managing flows of goods, and more associated with handling reciprocal interdependencies. A sequential interdependency can be described as where consumption is dependent on preceding phases of production. However, the quality of this supply is strongly embedded in various networked business relationships. Horsgaard & Co AS is clearly dependent on how well they network. While sequential interdependencies entail a neat linear configuration, this configuration does not fit well with this case. It is the complexity of a *network* rather than a more linear chain, as metaphorical mental model, that needs to be managed. Managing different business relationships, including those with transport firms, means that interdependencies are to a high degree reciprocal in the present state of the local foods network, thus resembling a service industry supply chain. Its shortness is possibly the reason why these reciprocal interdependencies are predominant. Transparency also implies that societal and natural environment concerns emerge as matters discussed in the interactions. In daily operations, this involves handling uncertainties associated with customer preferences as well as weather conditions affecting supply.

5.2. IT-enabled development in short food supply chains

Horsgaard & Co AS can be seen, through their logistics operations, to manually juggle supplies for different suppliers and supplies to different customers on a daily basis. This entails an inherent form of complexity in this local food network. The abundant use of manual forms of mutually adjusted orders are negotiated by e-mail or on the phone, reflecting a very limited use of IT. Automation of the information flow in this case is limited to the various information systems of the different companies involved in this local food network. These information systems are predominately manually interconnected. This use of intensive technology supports quality in business relationships characterized by reciprocal interdependencies. How one communicates needs to be standardized in order to increase pooled interdependency. This may be a lengthy, possibly continuous development effort. The question remains of whether such a standardizing effort is really called for in a small local foods network. Clearly, if the cost of IT is low enough, this will increase the attractiveness of increasing the automation in such network. Lowpriced IT involves off-the-shelf flexible software that can be used by smart phones or computers that companies in the network already have. But cheap technology isn't sufficient. It also really needs to be organized, which demands efforts and related manual costs, at least in the development and start-up phase. Accordingly, IT provides an opportunity to increasing pool interdependencies to integrate through mediating technology development.

5.3. Traceability systems and risk mitigation

Traceability is an ethically "right" resource to develop in all types of food chains. The case does not, however, reveal any explicit traceability system in use. Traceability is not formally organized in the network, except for registrations of the normal flow of goods. This still provides the necessary rudimentary traceability required by government. This system also reflects the status of the local foods network – that reciprocal interdependencies are abundant. If there is a demand for traceability, package markings coupled with order documents reveal where the goods came from. The tracing inquiry is then handled much the same way as the order was, by phone or e-mail. Given the limited use of traceability, including its importance in marketing, there is little reason to automate this function. However, the implementation of a more automated information system, better binding the actors in the local food network through increasing pooled interdependencies, could lead to integrating traceability as function within this system. This would enhance the quality of this system and could also be marketed to increasingly differentiate Horsgaard & Co AS as a quality seafood supplier. In relation to risk mitigation, such a traceability system would counter threats both in relation to the continuous ongoing production operations as well as market risks. Traceability, while being an important driver in modernistic food chains (Engelseth, 2009), does not play the same decisive role in driving integration in local foods networks. The economic perspective that traceability implies investment may be a cause for this lacking development. Use of IT is limited due to the lack of resources. This encompasses resources to invest as well as knowledge regarding how to use IT-based systems. This is accordingly a societal issue pertinent when considering IT-enabled process development in local food supply chains.

5.4 Complexity and efficiency concerns in local foods ecosystems

As discussed in the preceding section 5.1., this main production challenge is handled through the use of intensive technology that enables mutual adjustments. One of the prime facilitators of solutions to this complexity is networking. This means that the network is not a problem, even though more agents in the network makes it difficult for an individual person as Kjell Inge Kirkeland to comprehend it. The small size and its rather long history mean that the network is experienced by him as fairly transparent. Stability in the network is, in this case, the grounds of a management knowledge resource; that is, knowing how to do business in the local foods network of Horsgaard & Co AS. Over time, the uncertainties in relation to operations, features of supplies, and features of customer orders also repeat themselves. There is some degree of self-similarity here. This logic of complex systems may be applied to manage the local foods network, where navigation is associated with managing operations in a relatively stable network context is the rule. The notion that this context is an ecosystem creates an increased challenge to this view. By bringing in features of society and nature into this system, and not only considering the economic business processes, this seemingly increases complexity. This also expands the understanding concerning what is to be integrated in the local foods network. It also highlights the importance of ethics and the focus on long-term human wellbeing.

Regarding nature, its impact is already accounted for in supply, such as weather or production discrepancies in aquaculture production. Society also poses constraints regarding quality and safety regulations. Society and nature are already prevalent on the consumer side, society, since customers are increasingly concerned with the sustainability of production as well as that society's impacts on market trends. This includes the awareness of the sustainability of the production of local foods, which entails that applying an ecosystems framework is predominantly a research approach that formalizes and makes clearly explicit the impact of nature and society, in addition to business economic concerns. This role is not to be underestimated. By making nature and society more important in investigation, research aims – concerning balancing production with a combined societal and natural context – set network sustainability on both the business and the research agendas. In the current global society, with its increasing environmental and societal challenges, ecosystems thinking is clearly called for. It is closely interrelated with moving towards more sustainable food production, something that is inherently in the nature of local foods production due to its small-scale production that involves close interaction with both society and nature.

What makes local foods networks different from modernistic forms of food supply is that these networks are more transparent, and with small-scale production, are closer to nature and food traditions. Therefore, it is easier to grasp – both in practice and conceptually – the interaction between business, nature and society constraints in these local foods production processes. This closeness also entails that a paradoxical frame (Hahn et al., 2006) is best adapted to managing in local foods networks. This implies an understanding that application of this frame is not solely rooted in a quest for sustainable production, but that the local foods network is inherently complex, and therefore management in such networks is recommended to reduce the use of business plan frames, increasing their sensitivity to uncertainty and using flexible resources that are predominately pooled. Note that it is explicitly managing *in* the network (paradoxical frame) that is recommended, and not managing the network (business plan frame).

6 Conceptual modeling of connectivity in the local foods ecosystem

Local food production is fundamentally an economic activity. If local foods producers cannot turn up some form of profit from their production, they will necessarily close, unless they are subsidized by society. This section provides a conceptual model of the studied local foods network as an ecosystem. This implies that the roles of business, nature, and society constraints are made explicit. This is not the case in the purer logistical model in Figure 1. These two models should be compared in order for the reader to comprehend the contribution of an ecosystems understanding of food supply.

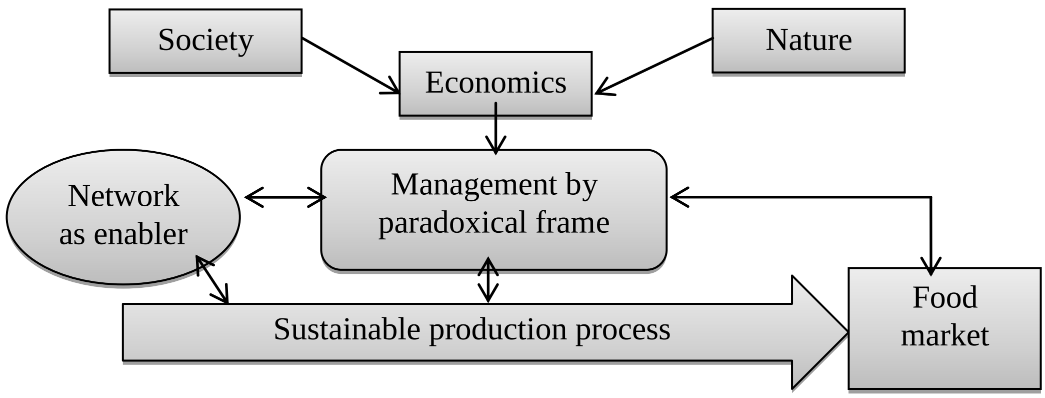

Figure 5. Food production conceptually modeled as an ecosystem

Figure 5 is a proposition of how to view local food supply as an ecosystem. The view presented in figure 5 is founded in systems thinking. The model is hardly self-explanatory, so some guidance is provided here. First, economics is viewed as a mediator between nature and society and management. This implies that the business is driven by a fundamental aim of securing its economic existence. However, this economic realm is intertwined with societal and nature constraints. Therefore, management is mainly concerned with reaching economic goals. This represents the principles that influence management. This management scheme is paradoxical, since managing is embedded in a deterministic discourse of management. This implies faith in a planning–implantation and control paradigm not well fit for managing exchange. This exchange economy (Hammervoll, 2014) is mainly associated with managing reciprocal and pooled interdependency rather than sequential interdependencies, for which this paradigm is best suited (Thompson, 1967). Food production in the local foods network is considered inherently sustainable, since the model includes societal and natural environment concerns on equal terms with the economic concerns. This sustainability is currently supported and therefore sustained through management, following a paradoxical frame. Therefore, based on this empirical evidence, a major challenge is to weaken this paradox through changing the prevalent management discourse to one that is more in tune with complex systems thinking that encompasses the triple bottom line factors, an ecosystems-based mental model. This represents an approach that increases awareness that economic constraints are not a hinder to sustainability as advocated by Hahn and Figge (2012), and therefore need to be balanced with societal and natural environment constraints, and that operations in such ecosystems are inherently complex. The complexity is not understood based on this empirically grounded analysis as designed into the system. Complexity is naturally there, and management needs to cope with this empirical fact. This may be surprising to readers thinking the local food supply involves a short and simple network of agents. These agents cope daily and naturally with economic concerns as their closest concern; nature and society's impacts are perceived through these economic concerns. An ecosystems approach helps to conceptually structure this inclusion of society and nature in managing local food supply, and hence further substantiates the need for complex systems thinking as a research approach to manage local food supply systems.

7 Concluding remarks

The model in Figure 5 represents a proposition and not a statement of reality in food supply. This implies that this model describes a set of interdependent propositions. These should be empirically grounded in future investigation. This may involve seeking to refine this model with increased conceptual detail. Furthermore, this model represents a specific view of what constitutes a food network as an ecosystem. Future investigation should elaborate on how and why the systemic propositions are beneficial both from an academic and business practice viewpoint. Further investigation should also reveal empirically founded weaknesses of the model. Further studies may also elaborate on the complexity of local foods ecosystems, elaborating on the use or non-use of a paradoxical frame. Finally, what explicitly characterizes "local foods supply" from an ecosystems viewpoint can also be investigated, including considering diverse types of local food systems involving (1) industrialized countries, (2) developing countries, (3) urban farming, (4) local foods production coupled with exports, and (5) variations in type of local foods supplies including features of traditional, organic, and high-tech food product design.

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