

Master's thesis – Master Sustainable Business and Innovation

Governance & Value chain Upgrading in circular food collaborations in the Netherlands



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Abstract

Food production is a primary cause of biodiversity loss and greenhouse gas (GHG) emissions.

This paper emphasises the need for a more sustainable food value chain through circular economy principles. The existing research argues that collaborations between different players in the food value chain are crucial for addressing negative environmental and social impacts. This paper proposes using global value chain theory to assess circular food collaborations, focusing on governance types and value chain upgrading to achieve economic, social, and environmental benefits within the circular food value chain.

A qualitative comparative design was used to explore how companies with different governance types manage collaborations to achieve various forms of value chain upgrading. Semi-structured interviews were conducted with companies involved in producing food products from waste or low-value streams, as well as other collaborators, including a facility company coordinating national government catering.

Two new governance types were coined: 'Local Social' and 'Easy Exchange'. Local Social governance promotes high economic upgrading through collaborative innovation and a strong focus on locality. This governance type integrates logistics, branding, marketing, and R&D, resulting in environmental and economic upgrading. The Easy Exchange governance type faced challenges in generating sales due to marketing issues and Dutch consumers' unpreparedness for the product. The results of this study emphasise the importance of knowledge exchange to mitigate complexity in the value chain, highlighting two methods:

long-term relationship-based knowledge sharing and codification. Next, The results of this study emphasize the significance of high capabilities in the supply-base, by the ability to produce high-quality products and provide CO2-impact numbers, especially in Local Social and modular value chains. Social upgrading tends to occur at the firm level rather than the collaboration level.

The paper concludes by suggesting further research to enhance the reliability, internal validity, and transferability of circular economy governance practices, particularly in the context of Easy Exchange governance. Moreover, managerial implications highlight the importance of collaborations in mitigating complexity and facilitating information and knowledge exchange. High complexity requires knowledge transfer through either codification or long-term personal relations between the parties in the collaboration. Additionally, high supply-base capabilities are crucial for catering to governmental companies now and in the future for all catering companies.

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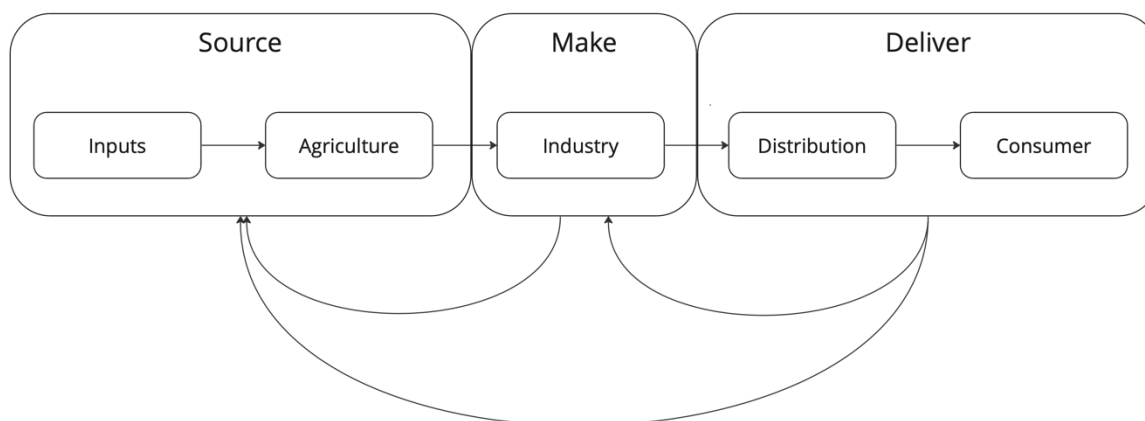
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Introduction

Food production is the primary cause of biodiversity loss and causes one-third of global Greenhouse Gas (GHG)-emissions (Ellen MacArthur Foundation, 2021). On top of that, approximately 30-50% of food intended for human consumption is lost in food value chains (FVC) (Forbes et al., 2021). These value chains are networks that link farmers, producers and consumers (Kumar, M. et al., 2022) in the processes of sourcing, making, and delivering (Golini & Kalchschmidt, 2019). The 'deliver' step of the FVC (households, retail and restaurants) accounted for 931 million tonnes of food wasted in 2019. That is more than double the amount earlier assumed in the literature, making the need to act even more urgent (Forbes et al., 2021). That is why this paper focuses on a more sustainable FVC. A form of a more sustainable FVC can be seen through principles known from circular economy (CE) literature (figure 1) where CE is defined as: "a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling." (Geissdoerfer et al., 2017; p. 759). In the FVC, wasted food is reused, by-products are utilized, and nutrients are recycled (Jurgilevich et al., 2016). However, sustainability aims to benefit not only environmental and economic benefits, but also comprises of a social part, which is often neglected in CE-literature (Geissdoerfer et al., 2017). Therefore, this paper also aims to include social aspects in a circular FVC.

Figure 1. *Circular value chain*



To build these circular FVCs, collaborations between the different parties operating in the value chain are needed (Bloise, 2020; Liaros, 2021). The setting-up process of collaborations in a circular value chain has been described in food packaging but how these collaborations are subsequently run to mitigate the negative effects on the environment and in social sense is still unclear (Calicchio Berardi & Peregrino de Brito, 2021; Jäger & Pisciselli, 2020), especially in food products themselves. In FVCs, collaborations have only been studied in farms, the sourcing stage, with a focus on reducing food waste (Bloise, 2020). This is unlucky as firms in the ‘deliver’ phase of the value chain, i.e. producers of consumer products, are in direct contact with consumers and can influence their ‘food environment’, nudging consumers to make more sustainable choices (Muscat et al., 2021). This is important as consumers are integral to the transition to a circular food system (Jurgilevich et al., 2016).

This paper aims to identify how collaborations in circular food value chains (FVC)s are governed to become more sustainable in an economic, social, and environmental sense. It argues that circular food collaborations should be assessed through the lens of global value chain (GVC) theory rather than traditional value chain theory. The highly integrated nature of collaborations makes GVC theory more suitable than the current literature focussing on supply

chain management (SCM), a theory that focuses on isolated pairs of firms (Golini & Kalchschmidt, 2019).

The GVC concept comprises two concepts known as 'governance types' and 'value chain upgrading'. The governance types explain patterns in how value chains are governed, and the concept of value chain upgrading refers to how value chains move from low-value to high-value activities in economic (Gereffi, 2019), social (Rossi, 2019), and environmental sense (Krishnan et al., 2023). This study focuses on how economic, social, and environmental value chain upgrading can be achieved within circular value chains in the food industry as a result of collaborative partnerships.

The relationship between governance types and sustainable value chain upgrading has been evaluated quantitatively within assembly industries (Golini et al., 2018) however, a qualitative approach to how collaborations are governed to achieve value chain upgrading in an economic, social and environmental sense is still lacking, especially in the empirical context of the food industry and a circular value chain. This is a relevant context because of the many new initiatives that have appeared in this area (Bakkers grondstof, ; Kipster, 2022; Lowlander, 2019). The focus on products on the 'deliver' stage value chain is relevant because of the tremendous amount of food waste that is seen in there (Forbes et al., 2021), moreover because of the potential for influencing consumers' behaviour (Muscat et al., 2021). For practical reasons the geographical scope of The Netherlands has been chosen. This leads to the following research question:

How does the governance of circular food collaborations relate to value chain upgrading in

The Netherlands?

To answer this research question, a comparative case study is performed on how collaborations producing circular food products from food waste or low-value streams for human consumption are governed to reach value chain upgrading.

This research will contribute to CE-literature where knowledge is lacking, especially about the social aspect of sustainability and governance of circular collaborations. This is done by providing empirical theory building through the combination of theories from different fields of science (global value chain theory, collaboration theory, and CE theory). This study adds a qualitative perspective to the quantitative knowledge of how different governance structures lead to different kinds of value chain upgrading.

Moreover, the unique empirical context will deliver new insights into the novel field of circular collaboration in the delivery stage of the value chain. For collaborations aiming to improve their economic, social, and/or environmental performance, the insights from this research can help design its governance structure in order to reach that type of upgrading.

For society, this research will contribute to the shift towards a circular food system, which is necessary to combat negative externalities associated with these linear value chains: biodiversity loss and climate change (Ellen MacArthur Foundation, 2021).

Theoretical framework

This theoretical framework starts with highlighting why collaborations are important for circular food supply chains, after which sustainability efforts will be viewed through the lens of global value chain (GVC) theory. First, the types of upgrading will be explained, after which the governance types will be elaborated, and a link will be made between the two concepts, illustrated in Figure 3.

Collaborations for Circular Food Supply Chains

A collaborative supply chain means “that two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation.” (Simatupang & Sridharan, 2002; p.19). Supply chain collaboration (SCC) has proven to be essential in building circular value chains to decrease food waste (Dora, 2019). Collaboration mechanisms and logistics influence both how much food waste is created throughout the value chain and the development of CE-practices, which results in circular value chains and sustainability within these CE-practices. This is because collaborations can help address the most prominent issues that cause food waste, such as ineffective infrastructure, packaging, and the lack of standards. Collaborations can help address these issues by e.g. developing (reverse) logistic solutions, intelligent packaging or improved warehouse monitoring (Viscardi et al., 2022).

Global Value Chains

Traditionally, Supply Chain Management (SCM) theory is focused on logistics activities within firms to establish a strategic advantage. This school of theory focuses on buyer-supplier relationships. However, due to globalisation and increased customer demands, several

scholars have argued for taking a broader view rather than focussing on isolated pairs of firms. Therefore, an assessment of value chain performance should be done using the GVC theory, as it focuses on the entire value chain (Golini & Kalchschmidt, 2019). In this study, the focus will be on flows starting from the delivery phase, as seen in Figure 1.

GVC is constituted of two pillars known as 'governance types' and 'value chain upgrading'. The governance types explain patterns on how value chains are governed based on three dimensions, as seen in Table 1 (Gereffi et al., 2005). This will be further explained in the chapter on governance types. The concept of value chain upgrading is concerned with how global value chains can capture more of the value they create (Golini et al., 2018) and is elaborated below.

Global value chains upgrading

The concept of value chain upgrading is defined as "how SC members can capture more of the value created and improve their positions in the global economy by following different trajectories" (Golini et al., 2018; p.13) These trajectories describe how value chains develop to capture more value. Next to an economic dimension, upgrading can also be seen in a social and environmental sense (De Marchi et al., 2019; Rossi, 2019). Participating in collaborations supports value chain upgrading in all dimensions, as the collaboration creates a learning opportunity to gain knowledge about markets, processes, and standards for the firms operating in the collaboration. The extent to which firms can learn from the collaboration depends on the collaboration's governance type (Golini et al., 2018).

Economic upgrading

Economic Upgrading (EconU) refers to “The process by which economic actors – nations, firms and workers – move from low-value to relatively high-value activities in global production networks” (Gereffi, 2005; p.171). Four trajectories have been identified (Gereffi, 2019):

A: Product upgrading in which economic actors move into more sophisticated products (lines) with higher value.

B: Process upgrading in which the efficiency of transforming inputs into outputs is made more efficient through the reorganisation of production systems or the usage of superior technologies.

C: Functional upgrading, which entails the acquirement of superior functions in the value chain or the abandonment of low value-adding functions.

D: Intersectional (chain-upgrading): Moving into a new sector using competence acquired in one's own sector.

In reality, these types of economic upgrading are hard to separate from each other. In FVCs, process and product upgrading cannot be distinguished because introducing new types of products is inherently connected to new processes (Gereffi, 2019). As, circular food products are a new type of product, it is expected that product and process upgrading will also be intertwined.

Social upgrading

Social Upgrading (SocU) is defined as: “The process of improvement in the rights and entitlements of workers as social actors, which enhances the quality of their employment.” (Barrientos et al., 2011; p.324). It involves enhancing labour conditions, protection and rights. With that, both the well-being of workers as well as the people dependent on them and local communities are benefited.

SocU can be divided in two components: (i) Measurable labour standards, which are easily observable and can therefore be quantified easily, e.g., wage level, and number of female supervisors. These standards are often the outcome of enabling rights. (ii) These Enabling rights are less easily quantifiable. E.g., non-discrimination, freedom of association, and the right to collective bargaining (Barrientos et al., 2011).

Environmental upgrading

Environmental Upgrading (EnvU) is defined as “The process by which economic actors move towards a production system that avoids or reduces the environmental damage from their products, processes or managerial systems.” (Marchi et al., 2013; p. 65).

Three types of EnvU can be distinguished: Product, process, and organisational, similar to what is seen in economic upgrading; however, goals are redirected from economic gain to environmental benefits. E.g., product upgrading is done through eco-branding, while process upgrading is seen in terms of eco-efficiency (Marchi et al., 2013).

The outcomes of environment upgrading are traditionally seen in terms of direct and indirect impacts on the natural environment. Direct outcomes are measurable, e.g., greenhouse gas (GHG)-emissions. Indirect outcomes are harder to measure and are externalised (De Marchi et al., 2019).

GVC Governance types

The second pillar of GVC-theory are governance types. (Gereffi et al., 2005) have constituted five types of global value chain governance, which are shown in figure 2.

These governance types are placed on a spectrum from low explicit coordination and power asymmetry to a high degree of explicit coordination and power asymmetry. The degree to which the governance type scores high or low on that spectrum is based on three elements, which are shown in Table 1: These factors are scored either high or low, which results in eight governance types, from which five are seen in reality and can be seen in figure 2.

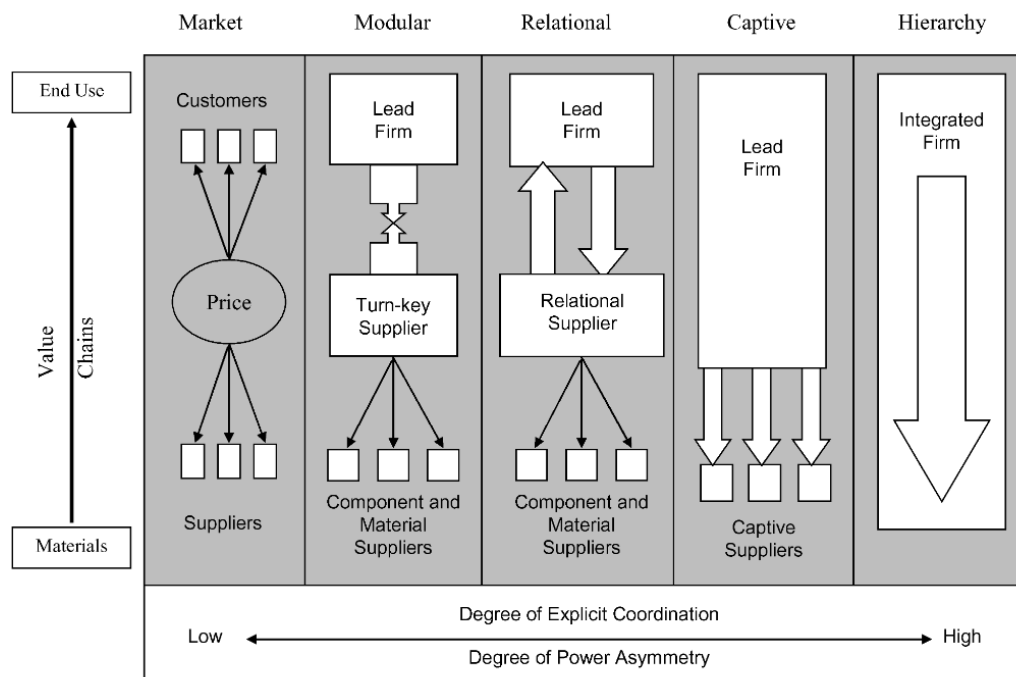
The complexity of knowledge transfer concerns the complexity of the information and knowledge required to sustain a particular transaction. The complexity increases when new demands are placed on the value chain (Gereffi et al., 2005). E.g. when a value chain moves into more complex products, the information needed to complete transactions between value chain partners is also increased. Because of the rising complexity, the lead firm needs more explicit coordination. This results in greater power asymmetry between buyer and supplier. To reduce these complexities, lead firms may adopt or develop technical and process standards. These standards codify information and allow for efficient hand-offs between partners.

The ability to codify transactions refers to the ability to standardise transactions. Codification allows for easy transmission of information between partners without the need for transaction-specific investments. When these standards become public and universally available, modularity can be seen, such that buyers and suppliers can easily be switched (Gereffi et al., 2005).

The capabilities in the supply-base refer to the capability of an actual or potential supplier to meet the requirements of the transaction (Gereffi et al., 2005).

Table 1. Governance types and their dimensions (Gereffi et al., 2005; p. 87)

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	Low
Modular	High	High	High	↑ ↓ High
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	

Figure 2. Five Global Value Governance Types (Gereffi et al., 2005; p. 89)

A consideration must be made on which governance types are relevant to assess.

Market governance types are regulated by prices set by sellers and interactions are governed with little to no coordination (Gereffi et al., 2005) therefore one could argue collaboration cannot be seen in this form of governance, as no integration between value chain partners can be seen. In hierarchy governance types, all processes are vertically integrated and R&D

and manufacturing is done in-house (Gereffi et al., 2005). Therefore one could argue that collaboration can also not be seen here. Modular governance types are almost exclusively seen in the electronics industry (Golini et al., 2018). Therefore, this research will focus on relational and captive value chain types. Similar to what is seen in quantitative studies on value chain upgrading as a result of different governance types (Golini et al., 2018).

Relational value chains

Relational value chains are seen when transactions are complex and product specifications cannot be codified. Supplier capabilities are high (Gereffi et al., 2005) and low formalisation results in tacit knowledge exchange (Gancarczyk et al., 2017a). The complexity of tacit information results in tight relations between partners. Value chain partners operate in networks characterised by frequent interactions (Golini et al., 2018) and often, the skills of the buyer and supplier are highly complementary (Pietrobelli & Rabellotti, 2011). The lead firm uses product design and knowledge transfer as governance instruments, whereas suppliers lead in technical knowledge on production processes. Through this power balance, new products and processes are created through co-development, rather than process integration by one powerful lead firm (De Marchi et al., 2019). Relationships are personal and power between the collaborating actors is balanced. Most coordination is done through face-to-face contact. A mutual dependency arises which may be regulated through reputation, social/spatial proximity, and family and ethnic ties. It is assumed relational governance types are medium centralised, as there is one lead firm controlling operations, but suppliers still hold a significant amount of power (Gereffi et al., 2005).

Mechanisms for supply chain upgrading in relational value chains

Quantitative research in assembly industries shows that relational governance with customers supports all forms of upgrading with customers. With suppliers, relational governance is associated with certain aspects of EconU and SocU (Golini et al., 2018). Mechanisms for EconU can best be described from literature on industrial clusters (Gereffi & Lee, 2016) as relational value chains often operate in networks. The governance for EconU is characterised by trust and mutual dependence. Social relationships govern economic transactions amongst firms and external parties. To overcome size constraints, small firms form clusters which are governed by institutions like clusters associations or chambers of commerce. This way resources can be shared, and collective monitoring can lower compliance costs (Gereffi & Lee, 2016).

One of the critiques often expressed is that private governance fails to address SocU issues because lead firms fail to engage with other actors in the value chain in fostering and monitoring enabling rights. Therefore value chain literature is moving towards multistakeholder initiatives that bring together lead firms, producers and civil society (Rossi, 2019). (Gereffi & Lee, 2016) have describe six trajectories for SocU in industrial clusters. The path with the most overlap with relational value chains is the 'Cluster driven path'. This path follows a bottom-up approach where cluster-firms improve labour conditions within the cluster collectively. This cluster-based action is driven by mutual dependence and trust between the closely knit firms. These initiatives take into account the local context and perspectives of that specific cluster (Gereffi & Lee, 2016).

Collaboration for EnvU can take a mentor driven approach In the 'mentor-driven' approach, the lead firm cooperates with suppliers. They mentor, co-invest in environmental

practices and innovation (Krishnan et al., 2023). However, a combination of top-down, bottom-up and mentor-driven approaches has been proven to lead to EnvU whereas only imposing formalised standards do not lead to EnvU, proving that a collaborative-based relationship results in improved environmental performance rather than compliance-based models (De Marchi et al., 2019).

Expectations for circular FVCs in relational governance

This type of value chain is characterised by medium explicit coordination and power asymmetry. Value is expected to be appropriated equally, as relationships between collaborating firms are built on trust and power is balanced (Krishnan et al., 2023). Because of the novel nature of circular FVCs, these firms often operate from industrial clusters. E.g. agro business parks (Bakkers grondstof,). Therefore, this governance type is expected to establish EconU in the formations of industrial clusters. SocU is expected to be established within clusters. Meaning that labour standards can collectively be established with collaboration partners (Gereffi & Lee, 2016).

For EnvU, it is expected to see a mentor-driven approach, where environmental issues are addressed through collaboration as that is most in line with relational value chain.

Captive value chains

Captive value chains appear when the ability to codify detailed instructions and complexity of the product are high, whilst supplier capabilities are low. Complex products are made by low-competence suppliers, requiring the lead firm to control and intervene in the supplying firm, resulting in high power asymmetry. This results in a transactional dependence, locking in suppliers. Opportunism is controlled by the lead firm whilst simultaneously

providing just enough resources and market access to make exiting unattractive (Gereffi et al., 2005). This form is also called 'quasi-hierarchical' (Golini et al., 2018) and the governance is seen as highly formal (Vazquez-Brust et al., 2020). Because there is one lead firm in charge of value chain operations, both centrality and hierarchy are considered to be high.

Mechanisms for supply chain upgrading in captive value chains

From quantitative research in assembly industries, we know that captive governance with customers supports some forms of EconU and SocU. For governance with suppliers, it supports some forms of EconU, SocU and EnvU (Golini et al., 2018).

For EconU, captive governance type has been associated with faster product and process upgrading. This is because the linkages between buyer and supplier are strong. This results in a greater exchange of knowledge. Functional upgrading, however, is locked out. Powerful buyers do not outsource value-adding activities (Golini et al., 2018).

Captive governance fails to establish SocU, especially in FVCs. Lead firms create pressure on suppliers in terms of costs, lead time, and last-minute responsiveness. This conflicts with labour standards and social upgrading efforts (Rossi, 2019). Lead firms might try to establish SocU in the value chain through codes of conduct and corporate social responsibility (CSR) efforts but empirical evidence shows that these methods are highly ineffective (Gereffi & Lee, 2016). Another critique is that lead firms cannot ensure enabling rights because they fail to engage with other value chain actors (Rossi, 2019).

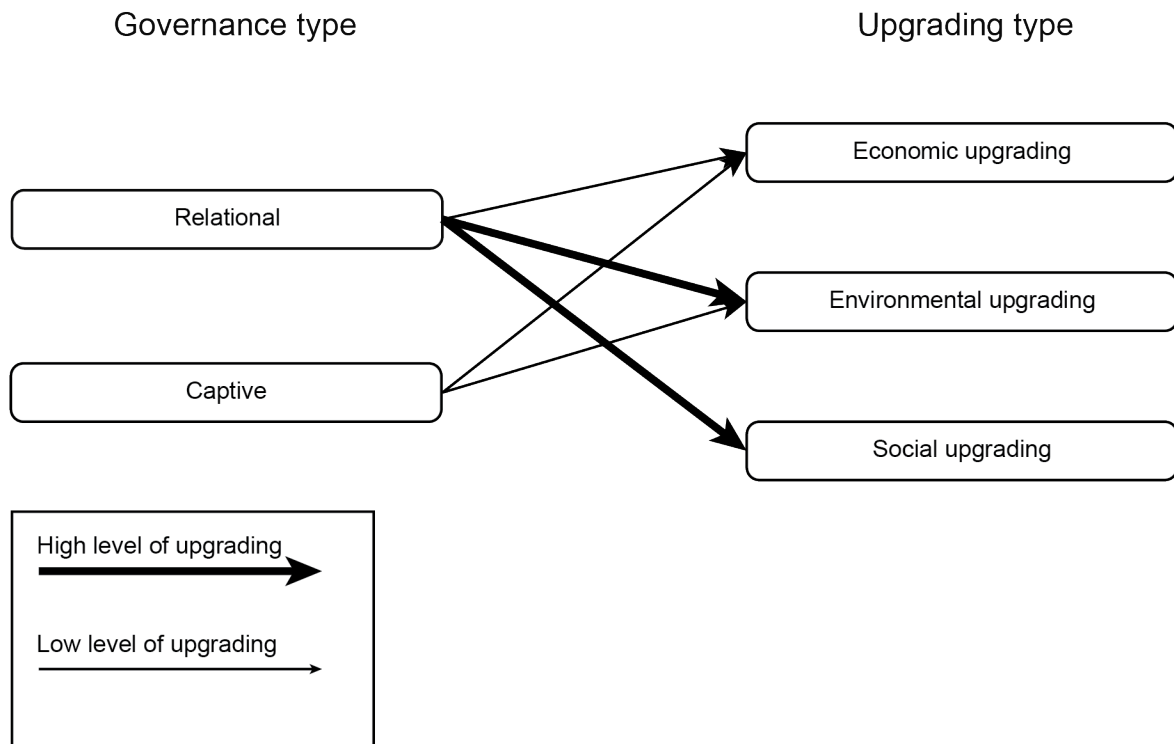
For EnvU, a captive relationship with suppliers is associated with improved environmental performance along the entire value chain. This is because of the use of environmental standards and certifications which the lead firm imposes on products by suppliers (Golini et al., 2018). This top-down structure is often seen in agricultural value chains

(Krishnan et al., 2023) and empirical research shows that environmental standards and contracts are also used in circular value chains (Cardoso de Oliveira et al., 2019). However, just because the overall environmental benefits are the greatest in this governance type, does not mean the environmental value ends up at every party equally. Because of power asymmetries, lead firms may claim all environmental benefits, even those that are not necessarily created by them. This is done through intellectual property, entitlements, and access. However, sometimes less powerful players may voluntarily transfer environmental benefits to the lead firm. In FVCs, farmers often have to accept deterioration of natural resources in the area they operate in, essentially absorbing the environmental damages of the entire collaboration.

Expectations for circular FVCs in captive governance

Valorisation of waste streams is a novel practice that is expected to be complex and requires a high degree of explicit coordination and knowledge sharing. As a high degree of knowledge sharing is associated with EconU, it is expected that captive governance increases EconU in general. However, value appropriation is expected to be unequal, as a powerful lead firm can claim economic benefits. SocU is not expected to rise because, in this governance type, one lead firm has control over the other firms. This means that the lead firm can set requirements regarding lead time product costs, at the cost of labour conditions for the workers, impacting the overall well-being of the workers and the communities they support. Moreover, in other industries captive governance types have failed to establish EconU. EnvU is expected to be high in this governance type because of the ability of lead firms to set environmental standards on their suppliers, either their own or third-party standards. E.g. percentages of recycled content.

All above described upgrading mechanisms have been conceptualised in figure 3.

Figure 3. *Conceptual framework*

Methods

This study aimed to assess how governance types of circular food collaborations led to different kinds of value chain upgrading. This research followed a deductive, qualitative approach.

The research design of this study was a comparative research design in which a comparison was made between how firms operating different governance types managed collaborations to reach different kinds of value chain upgrading. This research design was suitable because comparative research designs support theory building and contribute to the understanding of causality (Bryman et al., 2008). In this case, the aim was to understand how upgrading was achieved. The level of analysis was the entire collaboration.

Sampling strategy

First, efforts were made to find companies that made a food product from a waste or somewhat otherwise low-value stream and were operative in a collaboration. Then, both the waste stream's supplier and the product's customer were contacted for an interview to get a complete picture of how the collaboration was run. To do so, a combination of convenience and snowball sampling was used. However, companies often were not willing to share contacts, partners did not respond, or they were not willing to participate for various reasons. Mostly, the companies were operating with little personnel and were too busy to participate in such an interview. In the cases where the collaborators were not able to participate, only the party producing the food product was interviewed. Despite only interviewing one company in those cases, insights could still be gathered about the governance, as those companies were at the heart of the collaboration. Also, one facility company was interviewed

to gain a broader perspective on the procurement of circular food products. The following inclusion criteria were used to select the food producers. (i) The company must valorise a stream of food or food waste that would otherwise have been discarded or used at a lower value. (ii) The company must have been active in The Netherlands for more than a year. (iii) The product must be sold in The Netherlands.

Contacts from previous studies and an internship in the food industry were contacted. Moreover, companies were found through the members databases of Foodleap and MVO Nederland. Foodleap is a Dutch network of companies active in transforming the food system, and MVO Nederland is a network of companies active in corporate social entrepreneurship in The Netherlands. To sample companies suitable for this study, the filters were set on 'supplier/producer', 'new food processing techniques' and 'waste efficiency' in The Food Leap database, resulting in 94 companies, after which they were manually assessed as qualified with the inclusion criteria by looking through their websites. For MVO Nederland, the filter was set on agrifood, which resulted in 103 companies. After which these companies were also manually assessed to qualify for the inclusion criteria by looking at their website. Personal contacts and contacts at knowledge institutions were approached but resulted in 0 respondents. A total of 27 companies were contacted through telephone and email, resulting in 8 collaborations to be researched in 14 interviews.

Additionally, one facility company arranging the national government's catering was interviewed to gain insight into customer demands and required capabilities in the supply-base involved in circular food products the collaborations produced. Additional information about the collaborations was found on the websites of the companies active in the collaborations. That makes a total of 15 interviews, seen in table 2.

Table 2. *Overview of interviewed collaborations*

COLLABORATION	COMPANIES INTERVIEWED
CIRCULAR BREAD FROM SPENT GRAIN	Bread recycler (producer ingredient) Bakery company (producer food product) Marketing company (marketing & acquisition)
CIRCULAR COOKIES	Cookie company (producer food product) Processing company (producer circular ingredient)
GAZPACHO FROM 'B'-QUALITY VEGETABLES	Gazpacho producer (Producer food product)
OYSTER MUSHROOMS (BIG)	Government catering company (Seller product) Circular oyster mushroom grower (Producer food product)
CASHEWS	Cashew company (producer food product + seller)
CIRCULAR BREAD	Bread recycling company (recycling company) Bakery company (producer product) Marketing company (acquisition+marketing)
OYSTER MUSHROOM GROWER (SMALL)	Circular oyster mushroom grower (producer food product) High-end restaurant (Seller product)
OYSTER MUSHROOMS GROWER & BREWPUB	Microbrewery/pub (seller product + provider waste stream)
NATIONAL GOVERNMENT FACILITY COMPANY	National government facility company (facilitator circular catering)

Data collection

Data was collected through semi-structured interviewing. These kinds of interviews were characterized by both their structure through an interview guide (Table 3) and flexibility through their allowed room to elaborate on relevant topics. The choice of semi-structured interviewing was particularly fitting for a comparative study design like this, as some structure was needed to ensure cross-case comparability (Bryman et al., 2008).

The interviews were conducted face-to-face, through Zoom, Microsoft Teams or via phone call. The interviews lasted in between 30 minutes and one hour. A test interview was conducted with a circular start-up Groene Gevels member to verify the guide before the actual interviews commenced. This firm used discarded wood to produce façade gardens. Despite

being from a different industry, the firm operated in a circular value chain in collaboration with different partners. During the interview, economic and environmental upgrading efforts were found to be intertwined as they both consisted of ProdU, ProcU, FuncU, and InterU. Therefore, the choice was made to address this topic simultaneously instead of separately in the final interviews.

On top of the interviews, desk research was conducted for additional information by visiting the websites of the companies operative in the collaborations.

Table 3. *Interview guide*

TOPIC	QUESTION	FOLLOW-UP QUESTION
GENERAL	Please tell me about your specific collaboration. What do you do?	
	What is the aim of the collaboration?	
	Can you give a brief timeline of the collaboration?	
COMPLEXITY OF TRANSACTION	What information is communicated in the collaboration?	
	How complex would you say the information communicated is? And why?	
	How complex is it to communicate this information?	What makes it that easy or difficult?
	How efficient do you think the exchange of information is between partners?	Why do you think so?
CODIFICATION OF TRANSACTIONS	How are information and requirements of the product communicated?	How often is information communicated?

	To what extent are there standards or contracts in use?	
CAPABILITIES IN THE SUPPLY-BASE	Do you feel that all parties have the same amount of power in the collaboration?	Why do you think so?
ECONOMIC UPGRADING	How does the collaboration look like in cost structure?	
	How do you feel the collaboration is growing in economic sense?	
	What monetary information is shared between collaboration partners?	
ENVIRONMENTAL UPGRADING	What is the aim of the collaboration regarding environmental issues?	
	How do you feel that the collaboration is improving in environmental sense?	
SOCIAL UPGRADING	How do you think the collaboration makes a social impact?	
	How do you feel the collaboration is improving in social sense?	
	How are labour rights governed?	
	To what extent do the workers have a say in their own labour conditions?	
UPGRADING MECHANISMS	ProdU: How is the collaboration moving into new products?	How is this done for sustainable products?
	Procu: How is the collaboration improving in efficiency?	How is this done to improve eco-efficiency?
	How is the collaboration moving into new types of activities? E.g. marketing/branding, logistics, R&D, etc.?	How is this done to improve sustainability?
	How is the collaboration moving into new sectors?	How is this done to improve sustainability?
CAPABILITIES IN THE SUPPLY-BASE / SATISFACTION	How satisfied are you with the collaboration?	To what extent are you satisfied with the economic performance?

To what extent are you satisfied with the social performance?

To what extent are you satisfied with the environmental performance?

Operationalisation

Table 4. Operationalisation

GOVERNANCE TYPE	MEASUREMENT	INDICATOR
	Complexity of transactions	<p>Numerousness (the number of items, processes, SC partners, etc.)</p> <p>Diversity (heterogeneity of flows)</p> <p>Interdependency (Relationship between items, processes, partners, etc.)</p> <p>Variability (variability between expected and actual state of the SC)</p> <p>Variety (variety of components within the value chain)</p> <p>Uncertainty (difficulties as a result of lack of knowledge)</p>
	Ability to codify transactions	<p>Contracts were used to sustain the transactions between the collaboration partners.</p> <p>A formalised order system was used to sustain the transactions between the collaboration partners.</p> <p>Product standards were used in the collaboration.</p>
	Capabilities in the supply-base	<p>The end-user was satisfied with the produced product's qualities or properties.</p>

ECONOMIC UPGRADING	Product upgrading	One or more food products were introduced based on the same waste stream as the core product of the collaboration.
	Process upgrading	There were significant efficiency gains in the production process of the product. There were significant efficiency gains in the collaboration process. E.g. combining of orders.
	Functional upgrading	There was integration of marketing activities in the collaboration. There was integration of R&D activities into the collaboration. There was integration of branding activities in the collaboration. There was integration of logistics/distribution activities in the collaboration.
	Intersectional upgrading	The collaboration became active in an industry outside of the value chain related to the core product.
ENVIRONMENTAL UPGRADING		The collaboration mitigated material, water, and/or energy use. The collaboration mitigated pollution and/or waste production.
SOCIAL UPGRADING		An improvement of wages was seen in the collaboration. An improvement of working conditions was seen in the collaboration. An improvement in labour rights was seen in the collaboration.

	<p>An improvement of gender equality was seen in the collaboration.</p> <p>An improvement of economic security of workers was seen in the collaboration.</p>
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Table 4 outlines the operationalisation. The following paragraph will outline the scoring of measurements and indicators.

As value chains can be seen as a complex system, the scoring of complexity was interpreted as system complexity (Isik, 2011). If four or more out of six indicators were present, complexity was scored as high. Codification was assessed by the use of contracts in the collaboration, the use of product standards, or the use of order/planning systems (de Arruda Pollice & Fleury,). If two out of three of these indicators were present, it was considered to be high. For the capabilities in the supply-base It was assessed whether the food processing company could adequately convert food waste into food for human consumption that met customer requirements. The customer was considered to be the retailer or restaurant. This could be either within the collaboration or outside.

In the second phase, it was assessed what types of upgrading the collaborations established. To measure the level of product upgrading, it was considered whether the collaboration developed and sold one or more new products next to the core product made of the same source material. The level of process upgrading was measured by whether efforts were made to improve efficiency within the collaboration, both economically and environmentally. Functional upgrading encompasses integrating superior functions in the value chain (Gereffi, 2005). In this case, it was measured to what extent the collaboration integrated R&D, logistics, and/or marketing activities in the value chain, both in economic and environmental sense (Yoruk, 2019). If two or more out of four were integrated, it scored high.

For environmental upgrading, it was measured whether the collaboration mitigated material, water, and/or energy consumption and whether the collaboration mitigated pollution emissions and/or waste production (Golini et al., 2018). For social upgrading, it was assessed whether there was an improvement seen in wages, work conditions, workers rights, gender equality, and economic security of workers (Milberg & Winkler, 2011). If three out of five were considered high, the social upgrading was scored as high.

Data analysis

The interviews were audio recorded, after which the recordings were transcribed. Then, a deductive, thematic analysis was conducted. This was a suitable method for analysis as it allowed for cross-case analysis (Braun & Clarke, 2012). First, the transcripts were coded in NVivo. Based on the literature described above, coding was mostly done with a priori codes. Because this research was conducted in a new empirical context, new codes have also been created, as stated in table 5.

Table 5. Codes

CODE	A PRIORI/NEW
COLLABORATION IN SUPPLY CHAIN	New
COLLABORATION WITH CUSTOMERS	New
AFNAME AFSPRAKEN	New
AFNAMEVERPLICHTING	New
COLLABORATION WITH SUPPLIER	New
HIRED BY FOOD COMPANY	New
TENDER FACILITY OR CATERING COMPANY	New
COLLABORATION WITH CATERING COMPANY	New
COLLABORATION WITH EXTERNAL PARTNER	New
COLLABORATION WITH EDUCATION	New
COLLABORATION WITH SOCIAL WORKPLACE	New
COMMUNICATION TOWARDS CUSTOMERS	A Priori
COMPLEXITY OF INFORMATION	A priori

HIGH COMPLEXITY	A priori
SPECIFICATION	A priori
DESCRIPTION OF ACTIVITIES - DESCRIPTION OF SC	A priori
MAIN GOAL OF COLLABORATION	A priori
DOMINANCE OF PARTIES	A priori
ECONOMIC UPGRADING	A priori
FUNCTIONAL UPGRADING	A priori
LOGISTICS	A priori
MARKETING	A priori
INTERSECTIONAL UPGRADING	A priori
PROCESS UPGRADING	A priori
EFFICIENCY	A priori
PROCESS UPGRADING - EOCNU	A priori
PROCESS UPGRADING - SOCU VS ECONU	New
PRODUCT UPGRADING	A priori
UPSCALING	New
ECONU VS ENVU	New
ENVIRONMENTAL UPGRADING	A priori
ENVU - FORMALISATION	New
ENVU - PROCESS UP	A priori
ECO-EFFICIENCY	A priori
ENVU - PRODUCT UPGRADING	A priori
ENVU- PROCESS UPGRADING	A priori
ENVU-INTERSECTIONAL	A priori
SUSTAINABILITY GOAL	A priori
ENVU VS SOCU	New
INFORMATION SHARING	A priori
CONTACT	A priori
CONTACT - FORMALISED	A priori
CONTRACTS	A priori
EXCLUSIVITY CONTRACT	New
FORMALISATION	A priori
FORMALISED CONTACT - FOOD SAFETY	New
FOOD SAFETY	New
STANDARDS	A priori
PRODUCT REQUIREMENTS	New
CONTACT - INFORMAL, PERSONAL	A priori
DAILY CONTACT	New
EFFICIENCY OF COMMUNICATION	New
FREQUENCY OF INTERACTION	New
NO CONTACT	New
KNOWLEDGE EXCHANGE	New
LAW IS A RESTRICTION	New
SATISFACTION	A priori
SATISFACTION - ECONOMIC	A priori
SATISFACTION - ENVIRONMENTAL	A priori
SATISFACTION - SOCIAL	A priori
SOCIAL UPGRADING	A priori
KLEINERE INITIATIEVEN	New
SOCIETY NOT READY	New
WANT TO INLCUDE EVERYONE	New
WORK CONDITIONS	A priori

The analysis consisted of three phases: First, the governance type of the collaboration was assessed by scoring either high or low on the determinants constituting the governance type (table 4), second, the analysis focused on which types of upgrading were seen. In the third phase, the analysis focused on how the different collaborations governed value chain upgrading. First, the different parties operating in the same collaboration were analysed simultaneously, as the level of analysis encompassed the entire collaboration. The aim was to compare how collaboration conducted value chain upgrading efforts compared to collaborations operating a different governance type. This allowed for cross-case analysis in which patterns that were universal for that governance type as a whole were analysed. However, no such patterns were found. Therefore, the analysis shifted to the determinants of governance types: Complexity of transactions, ability to codify transactions and capabilities in the supply base. First, the analysis identified which determinants correlated with specific types of upgrading, or whether low scores on certain determinants were linked to low levels of specific upgrading types. When either one was the case, patterns of upgrading efforts were identified through thematic analysis. This method was repeated for the other determinants. During the analysis, it became apparent that scores on determinants in modular and relational governance types had the opposite effect on specific upgrading efforts compared to captive or market governance types. Therefore, the dynamics for upgrading efforts were analysed separately for these two groups of governance types.

Results

This chapter consists of three parts. First, Two newly discovered governance types are described. After that, a within-case analysis is given in which the different supply chains are described, and the type of value chain governance is established based on the three determinants: Complexity of transactions, ability to codify transactions, and capabilities in the supply-base. The analysis for value chain upgrading can be found in Appendix I. After that, economic, environmental, and social upgrading efforts will be described for each collaboration. After that, a cross-case analysis was performed to establish patterns of how the elements constituting supply chain types are associated with supply chain upgrading in an economic, environmental, and social sense.

New governance types

Two new governance types were found previously not known in the literature. Therefore, two new names were developed for these governance types.

The first governance type was characterised by low transaction complexity and low ability to codify transactions but high capabilities in the supply-base. The collaborations operating this governance type had low complexity as the flows used in the collaboration were simple. Moreover, the interdependency was low as the companies could still operate without the partners. Because complexity was low, these collaborations did not need high levels of codification to share information and knowledge. Also, no formal contracts were used to sustain transactions as the collaborations were built on long-term relationships. These relationships resulted from long-term innovative collaborations that invented new ways of

upcycling food waste and applying them in consumer products. Because the size of these collaborations were considerable, food safety standards were in use. The capabilities in the supply-base were high, as these collaborations offered novel products based on unique production processes. Moreover, sustainability reports were developed to meet customer demands that require such reports. The collaborations operative in this governance type had a focus on locality and operated in physical proximity to each other. Their relationships were built in long-term mutual trust; thus, the name Local Social was coined for this governance type.

The second new governance type was characterised by low complexity, low ability to codify transactions, and low capabilities in the supply-base. Collaborators established a company where they all became shareholders, governing their collaboration through far-reaching personal relationships rather than governance dynamics seen in traditional value chains. The complexity was low, as very little was produced. Moreover, all players in the collaboration also ran their own companies in the agrifood business so they were not dependent on each other. Also, knowledge was similar, which resulted in low variety between the players. Because complexity was low, there was no need for codification. The players in the collaborations knew each other, so trust was high, based on personal relationships. Relationships with external partners were also based on trust, as the parties were active in the agro-food industry for a long time. The capabilities in the supply-base were low, as this type failed to produce a product that satisfied customer demands. Because all parties in the collaboration operating this governance type were long-term acquaintances, knowledge was similar, and they were part of the same company, information and knowledge exchange was extremely easy. Therefore, the name Easy Exchange was coined for this governance type.

Overview of collaborations

This section will describe the different collaborations studied.

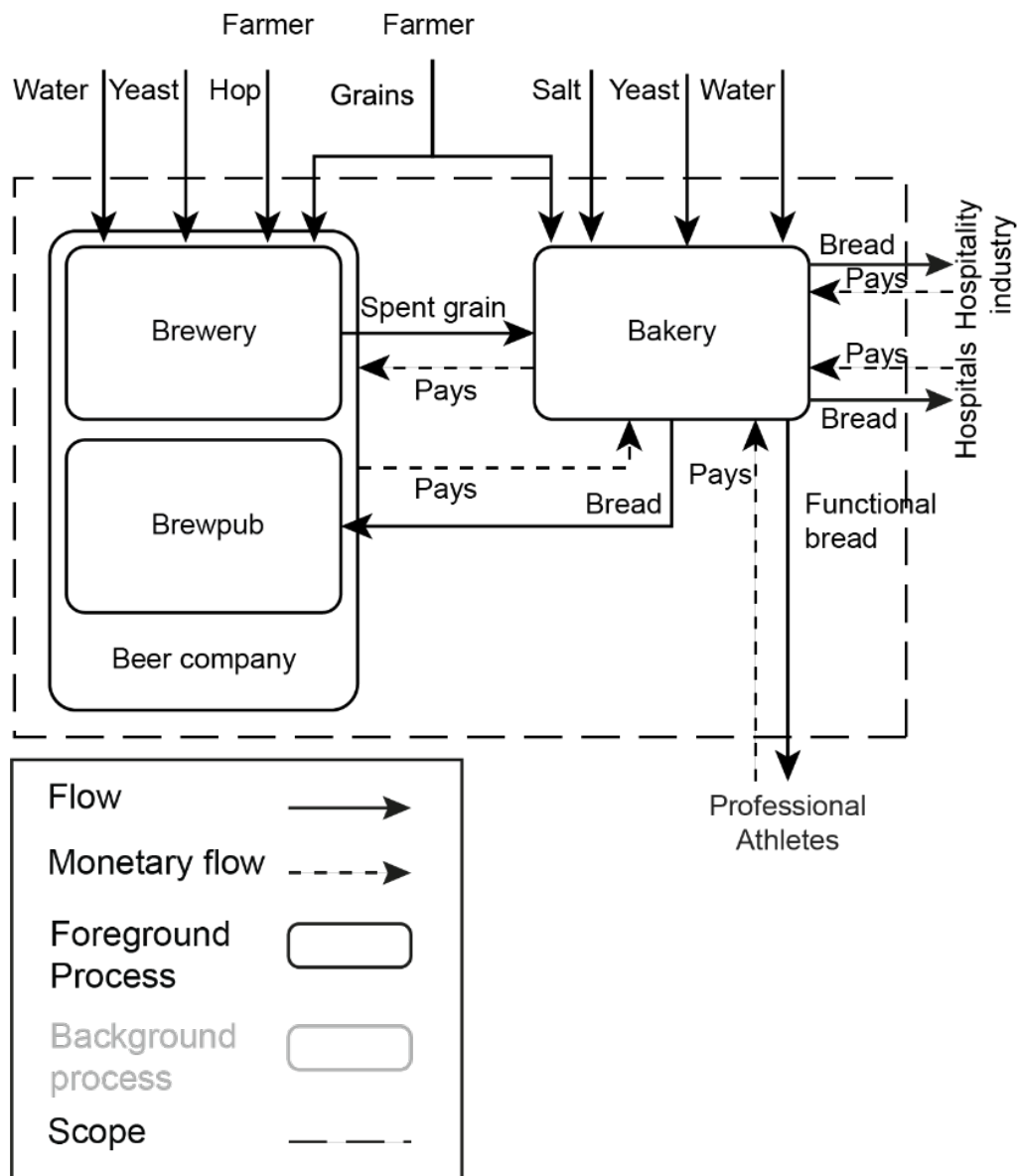
Circular bread from spent grain (Local Social)

This collaboration consists of a brewery and a bakery producing bread from spent grain that would otherwise be used as animal feed. The collaboration started in 2017 and involved the bakery's own knowledge institute.

The brewery delivered spent grain to the bakery, which produced bread used in the brewery's brewpub and hospitality industry, see figure 4. Next to that, the healthy properties of the particular bread were used in hospitals and professional sports teams. The collaboration was based on the personal relationship of the two owners and was rooted in a passion for locality and sustainability.

The bakery paid a fee for the spent grain, and the brewpub paid for the bread.

Figure 4. Circular bread from spent grain including monetary flows, own work based on interviews



Because spent grain is a rest product from the brewing process, it was not legal to use for human consumption. Therefore, a special valve had to be developed in the brewing tank to drain it and legally use it for human consumption. Moreover, the spent grain had to be transported frozen. Food safety standards were used in the collaboration to ensure food safety. No further contracts were utilized as trust was built on a 20-year relationship. The two companies had similar knowledge as beer and bread only differed in one ingredient.

Moreover, the two companies used the same farmers to grow their grains. The spent grain naturally contained a special fibre: beta-glucan, which lowers cholesterol and was therefore wanted by hospitals and professional sports teams for its healthy properties.

Next to bread, other products were also introduced like nonnevotten (a kind of local pretzel), bitter balls or stroopwafels. This product development was done on knowledge exchange between the bakery's own knowledge institute and other knowledge institutes and students. Some efficiency improvements were seen in the purchasing of a new proofer machine in the bakery and eco-efficiency gains were seen in the use of green energy to power the bakery but no efficiency gains were seen on the level of the collaboration.

The bakery employed and educated people with a distance to the labour market and Ukrainian refugees. Bakers were employed through the collective labour condition for hospitality but were paid above the wage that was stated in the collective labour agreement for bakers. They were able to influence the purchase of new machinery in the bakery, but salaries were not up for discussion.

Complexity of transactions

The complexity of transactions was low. The flow of spent grain was significant but not massive. Diversity was low, as only one flow of spent grain was used to produce the bread. Interdependency was low, as both companies could run without each other. Variability was low as there was no discrepancy between the expected and actual value chain. Variety was low as the companies were similar in the sense that bread and beer have 75% the same ingredients.

Ability to codify transactions

The ability to codify transactions was low. No contracts were used. Orders were supposed to happen through an excel sheet but was often not used in practise. Food safety standards were in place.

Capabilities in the supply-base

The capabilities in the supply-base were high as high-quality (functional) foods were produced based on knowledge within the collaboration.

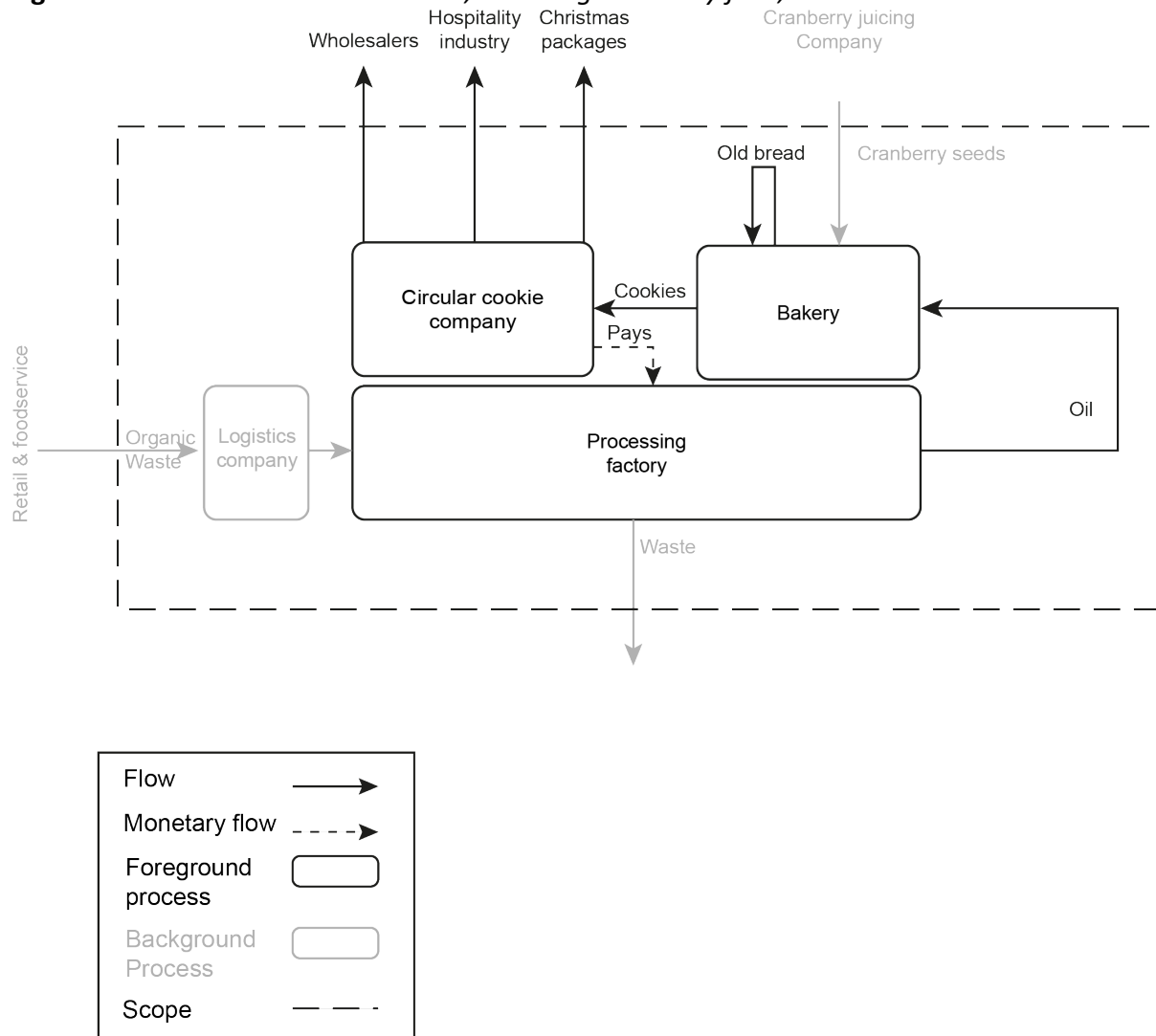
Conclusion

In conclusion, a local social governance type was seen. Complexity was low, ability to codify transactions was low and capabilities in the supply-base were low. Therefore the governance type was classified as local social.

Circular cookies (Local Social)

This supply chain comprised a processing company producing multiple products from leftover organic wasre from retail and food service and a cookie company utilising various ingredients based on a waste stream, see figure 5. The processing company produced, amongst others, a flavoured oil and experimented with a new kind of fibre extracted from the organic waste. The cookie company sold cookies made from recycled bread from the bakery, oil from the processing factory and other valorised ingredients to wholesalers, the hospitality industry and Christmas packages. The processing company had the capacity to process 30 million kilos of organic waste per year. The cookie company paid for the oil.

Figure 5. Value chain circular cookies, including monetary flow, based on interviews



The collaboration could be distinguished into two different typologies. One typology centred around a single pressed oil, and the second involved a newly developed fibre. The cookie company ordered and used the oil like any other fruit oil would be used. The fibre, on the other hand, was a more collaborative effort as an application specialist from the processing company codeveloped the application together with the cookie company and bakery. Formalisation was seen in food safety standards for the processing factory and the bakery, as this was a requirement for wholesalers.

Product development was based on knowledge exchange in two directions. The processing company conducted internal R&D activities to extract new ingredients like fibres from the organic waste. Subsequently, the application was developed with innovative companies like cookie companies and connected bakeries. Once developed, the aim was to lower the price to make the ingredients a viable alternative for the standard ingredient, as seen with the oil that the cookie company ordered, like any other ingredient.

Efficiency gains were seen in the combination of orders and decreasing lead times. This was done for both sustainability and economic gains.

The processing company worked with people with a distance to the labour market, even though the cookie company detested that. In the bakery, women were employed through a collective labour agreement and were often inspected by the cookie company.

Complexity of transactions

The complexity of transactions was low in this collaboration. The diversity was low, as only one ingredient was used. Interdependency was low, as both companies could run without each other. The ingredient was identical to the conventional variant; it just came from a different source. Variability was low, as there was no difference between the existing and expected value chain.

Ability to codify transactions

Low codification was seen. No contracts were used, as the collaboration was running for a long time and the processing company tried to keep a personal connection with innovative companies like the cookie company. Moreover, no formalised order systems were seen.

As the cookie company sold to big wholesalers and hospitality chains, they needed to adhere to food safety standards. To achieve compliance, they outsourced their baking to a professional bakery. Additionally, the cookie company only worked with suppliers who provided a data sheet with food safety information.

Capabilities in the supply-base

The capabilities in the supply-base were considered high, as it satisfied customer demands: A tasteful, high-quality cookie made from sustainable, circular ingredients.

Conclusion

In conclusion, a local social governance type was found for this collaboration as complexity was low, ability to codify transactions was low and capabilities in the supply-base were high.

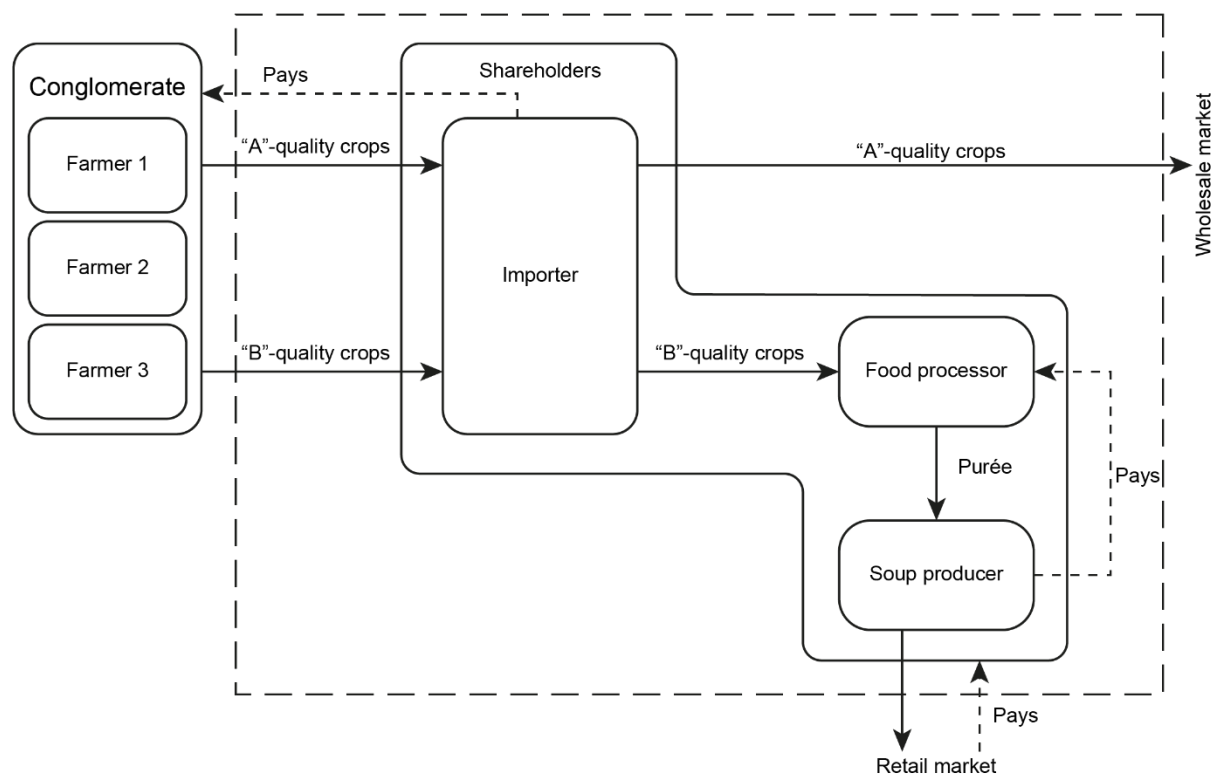
Gazpacho from 'B'-quality vegetables (easy exchange)

This supply chain comprises three shareholders that together form a single company processing wasted fruits and vegetables (figure 6). This may seem like a hierarchy governance type, however, the suppliers of the waste stream were not integrated into the company. The importer imported fruit and vegetables from conglomerates around the equator for the consumer market. However, some of the produce was not directly suitable for consumers. E.g. due to a wrong size or harm to the skin. The importer imported the 'A' quality and 'B' Quality produce. The 'A'-quality produce was sold through the regular channels, and the 'B'-quality produce was used to produce a gazpacho as a healthy, refreshing drink for the to-go market

like train stations. The company was established in 2021, but sales have been lacking due to failed marketing efforts.

The soup producer paid the food processor for the production of puree and the importer paid the conglomerate for the 'B'-quality produce.

Figure 6. Value chain gazpacho from 'B'-quality vegetables. Based on interviews



Formalisation was seen in forming one company where the importer, processor and soup producer were formalised into shareholders. The collaboration was based on personal relationships; all members were experienced entrepreneurs in the agri-food industry. The collaboration found it hard to please customer demands as demand for to-go gazpacho was lacking.

Complexity of transactions

The complexity of transactions was considered to be low. Numerousness was low, as there were no sales. Diversity was high, as several different ingredients were used. Interdependency was low, as this concept was just a side job for the importer. The collaboration between importer and conglomerate still ran without the production of gazpacho. Variability was high, as expected sales were not taking off. Variety was low, as all players in the collaboration were already active in similar companies. Uncertainty was low, as knowledge was similar among all collaboration players.

Ability to codify transactions

The ability to codify transactions was low as no contracts or formalised order systems were used because of personal relationships between shareholders and the relationship between the conglomerate and the importer.

Capabilities in the supply chain

The gazpacho company were not able to satisfy customer demands. The collaboration tried to sell the product to a retailer but this was unsuccessful so customer demands could not be met.

Conclusion

The complexity of transactions, ability to codify transactions, and capabilities in the supply chain were low. The governance type could not be established based on the

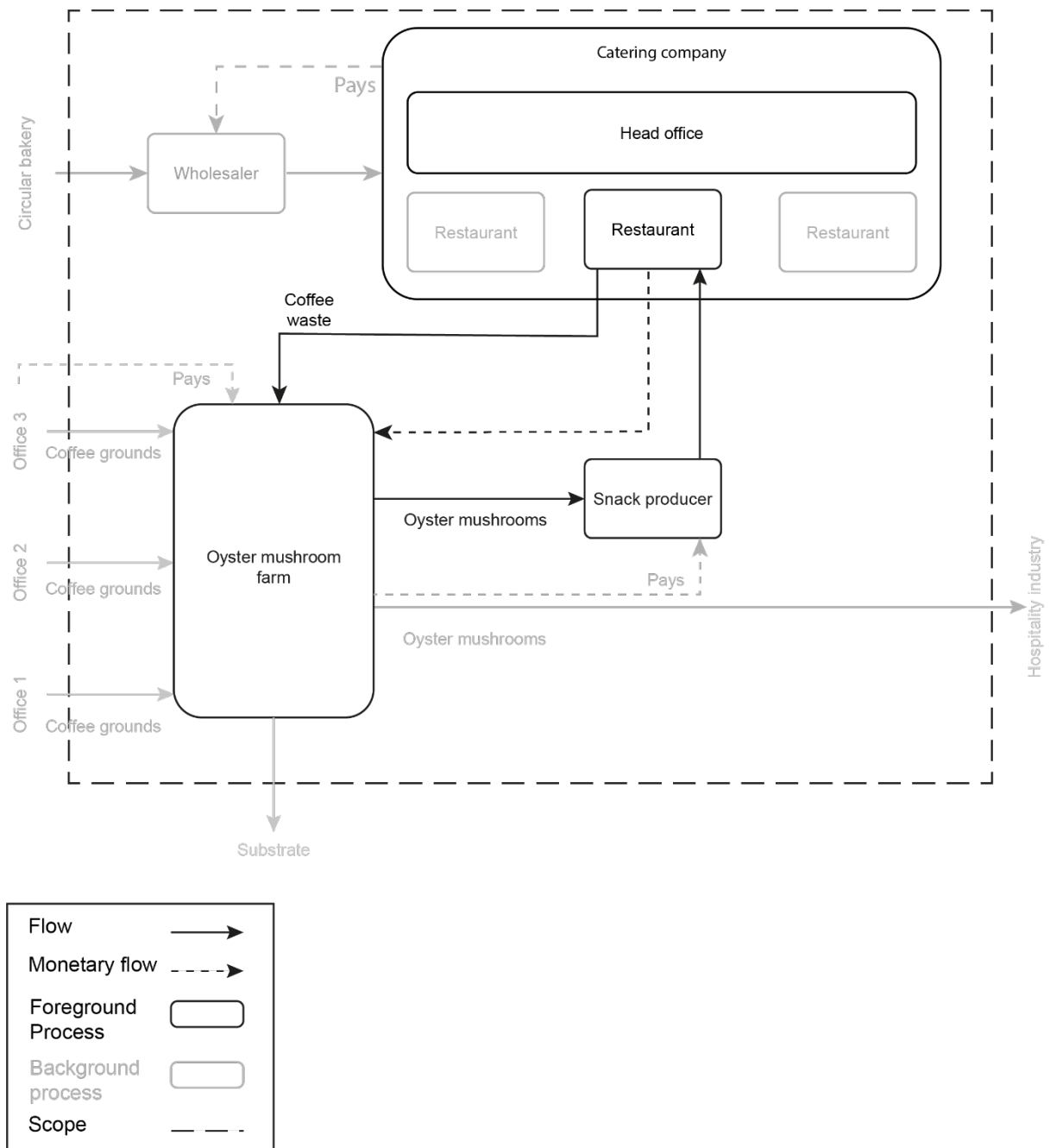
governance types established in the literature. Therefore a new governance type was coined: Easy Exchange. This type is signified by the personal relationship of the partners collaborating in the collaboration and seamless integration of transactions as a result of integration into one company.

Oyster mushrooms, big (market)

This collaboration consisted of one location of a corporate catering company and an oyster mushroom grower that used coffee waste to cultivate oyster mushrooms and produced deep-fry snacks (figure 7). The catering company served 350 locations throughout The Netherlands, and the oyster mushroom grower produced between 110,000 and 140,000 oyster mushroom snacks per year, based on coffee waste collected from several locations. The catering company chose the oyster mushroom snacks because they had to reach the sustainability Key Performance Indicators (KPIs) set by the government, and sustainability was intrinsically part of the catering company's DNA.

The catering company paid for the coffee waste collection and the deep fried oyster mushroom snacks.

Figure 7. Value chain oyster mushroom grower, big, including monetary flow, based on interviews



For the coffee to grow oyster mushrooms, it had to be clean and contaminant-free, but no quality standards were used, and the quality of the coffee waste was lacking. Therefore, the oyster mushroom grower had to build a sterilisation plant.

Formalisation was seen in food the catering company's sustainability KPI's as a result of the government's sustainable purchasing policy. Therefore, the catering company calculated the CO2-impact of all the products used in their restaurants and used an internal scoring mechanism for sustainable purchasing. Formalisation was also seen in the use of food safety documents. Moreover, the catering company conducted supplier audits.

The collaboration with the oyster mushroom farm was satisfactory for the governmental bodies as sustainability efforts were formalised through CO2-impact reports, an internal scoring system, and the process of reaching the targets set in the sustainability KPIs.

No collaborative efforts for social upgrading were seen in the collaboration with the oyster mushroom farmer, as it was a purely transactional relationship.

Complexity of transactions

The diversity was low, as the collaboration only comprised of a flow of coffee waste and oyster mushroom snacks. The interdependency was low, as this collaboration was just a small part of the overall business activities and both companies could run without each other. The variability was low, as there was no discrepancy found between the expected and actual value chain. The uncertainty was low, as there were no difficulties as a result of a lack of knowledge.

Ability to codify transactions

The ability to codify transactions was found to be high. A formalised order system was in place through the website of the oyster mushroom grower and codification was seen in CO2

impact reports. The catering company requested these reports. Moreover, the catering company conducted audits.

Capabilities in the supply-base

The capabilities in the supply-base were considered to be high. The products were of good quality and the oyster mushroom grower was able to provide CO2-impact numbers.

Conclusion

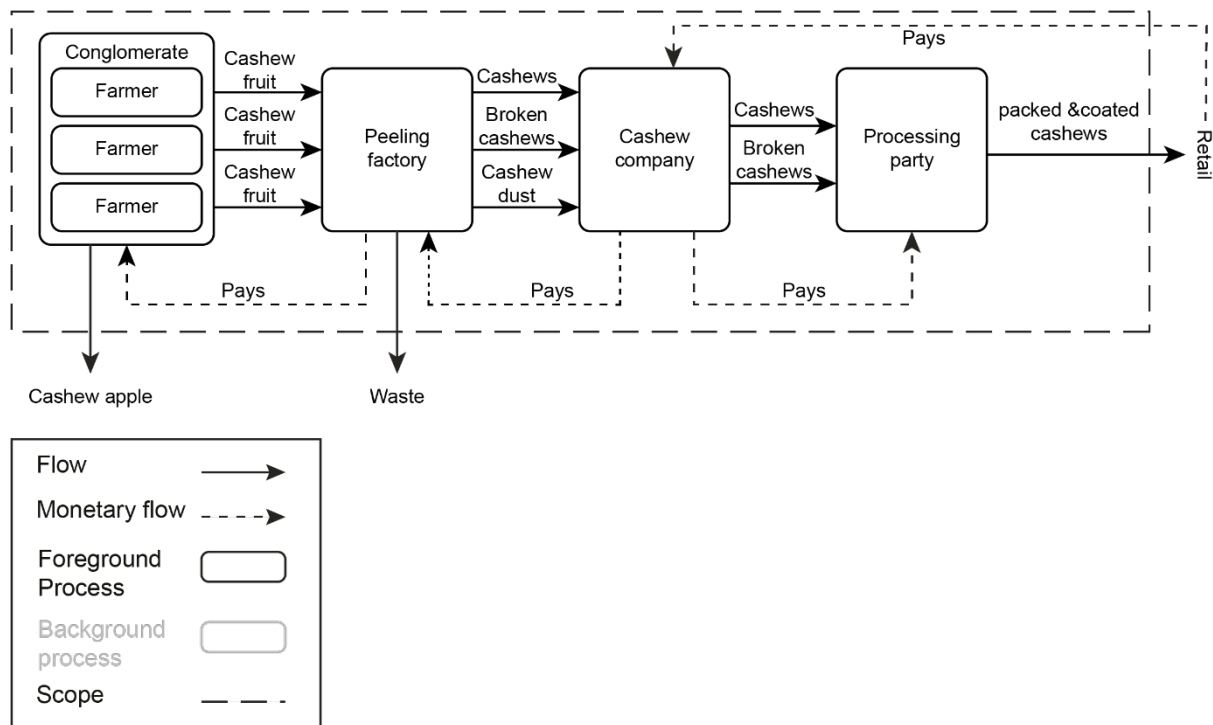
In conclusions, a market governance type was seen. The complexity was low, the ability to codify transactions was high, and the capabilities in the supply-base were also high. Therefore this collaboration was classified as market.

Cashews (modular)

This collaboration comprised a Dutch cashew brand, a cashew peeling factory and a conglomerate of cashew farmers selling a mix of flavour-coated cashews and broken cashews in retail outlets in The Netherlands (figure 8). Traditionally, cashews meant for the Dutch market were harvested in Africa, peeled in Asia, and sold in The Netherlands. In the peeling process, part of the cashews break and are sold as an ingredient to the food industry for a lower price. In this collaboration, however, these “detour kilometres’ were eliminated, and cashews were peeled in the area of harvest. Moreover, the Dutch cashew brand purchased all cashew grades at full price from the peeling factory and paid a premium for all cashew grades. The payments were made to the peeling factory, which paid the conglomerate. The collaboration started in 2022 and has sold 1 million bags of cashews in the first year, despite

being 1,5 to 2 times more expensive than traditional cashews. The cashew company in The Netherlands did marketing.

Figure 8. Cashew chain including monetary flows, own work based on interviews, based on interviews



The relationship between the cashew company and the peeling factory was good but based on business. Traditionally, the cashews would be transported to Asia for peeling; however, the peeling was done in the same area. Moreover, the broken cashews were used for human consumption rather than as an ingredient in the food industry. Every season, contracts had to be renewed between the cashew company and the peeling factory. Moreover, a complex industry standard grading system was used to determine the quality of the cashews. One million bags of the (broken) cashew mix were sold within the first year of being in business, so customer satisfaction was high.

The (broken) cashew mix was the only product introduced. However, R&D was conducted to develop ice cream and cheese alternatives based on cashew dust, the lowest

cashew grade. Efficiency gains were seen in the collaborative mechanisation efforts of the factory in Tanzania. However, efficiency gains in the collaboration between the players in the collaboration were not seen.

The cashew company paid a price premium for the cashews to secure a liveable income wage for the farmers and people working in the factory. The latter were mostly women who often had their money taken by their husbands. Therefore, help was offered to open a bank account to ensure financial independence to these women. Also, they received reading and writing education.

Complexity of transactions

The complexity of transactions was high. The numerosness was high, as 125,000 kg of cashew mix was sold in one year. The diversity was low, as there was only one flow of cashews. The interdependency was high, as the Tanzanian companies depended on the Dutch cashew company for a liveable wage. The variety was high, as farmers, peelers, and the Dutch cashew company were very different companies. The uncertainty was high, as a lot of knowledge was shared within the collaboration. E.g. about new cashew breeds or market dynamics.

Ability to codify transactions

The ability to codify transactions was high as there were contracts in place that had to be renewed every season. No formal ordering system was used, as there were hardly any computers in the Tanzanian factory. Industry-wide product standards were in use in the form a grading system of 29 different cashew grades.

Capabilities in the supply-base

The capabilities in the supply-base were high as customer demands were met. The cashew company coated the (broken) cashews in a tasteful coating and packaged them in an attractive packaging. The customer demand for a fairly produced, more sustainable alternative to conventional cashews was met, resulting in the sales of a million bags in the first year of production.

Conclusion

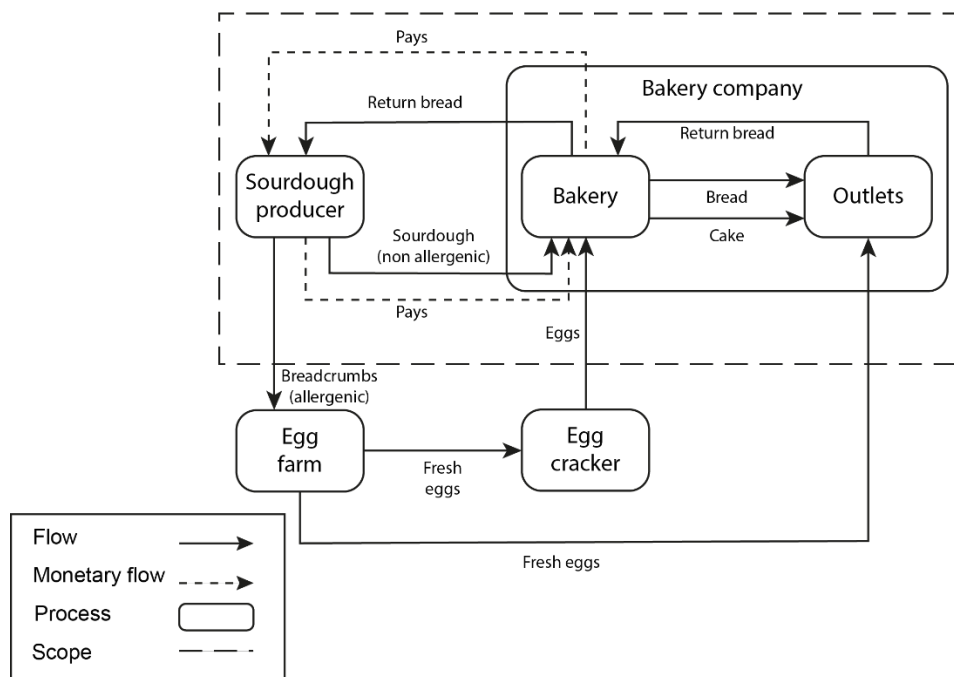
In conclusion, a modular governance type was seen, as complexity was high, the ability to codify transactions was high, and the capabilities in the supply-base were high.

Circular bread (Modular)

This supply chain comprised a baking company with a factory, several bakery outlets, a sourdough manufacturer and a marketing company (Figure 9). The sourdough manufacturer recycled unsold bread into a sourdough used by the bakery to bake new bread. The collaboration started in early 2022, and the bread recycler processed 5000kg of returned bread per day. The concept was launched in January 2023 at Horecava, the biggest and most crucial hospitality fair in The Netherlands. 15% of returned bread was donated to the food bank.

The sourdough company paid a small fee for the returned bread, and the baking company paid the sourdough company for the sourdough. Marketing and sales were done through collaboration with a third party, an emerging bakery corporation.

Figure 9. Supply chain circular bread, including monetary flows, own work based on interviews



The flow of unsold bread to the sourdough company exhibited heterogeneity in ingredients and allergen composition due to variations in recipes employed by different bakeries. Therefore, each bakery in the sourdough company had its separate recycling process. This resulted in high levels of asset specificity because every bakery required a recycling machine.

Information about ingredients and specifically allergens had to be communicated between supply chain partners and production methods to comply with strict industry production standards based on food regulations. These production standards, Hazard Analysis and Critical Control Points (HACCP), required standardisation and efficient information exchange between supply chain partners. This resulted in a high ability to codify transactions.

The development of an in-house recycling machine and the above-described process speaks to the ability of the collaboration to satisfy customer demands.

The personal relationships between the supply chain partners and similar backgrounds as a baker allowed for easy knowledge transfers, allowing the development of higher margin products such as kvass, granola and pita rolls, also in collaboration with knowledge institutes. Sometimes, product development was conducted based on customer requests. For example, a catering company requested a new shape of loaf to mitigate cutting waste, contributing to environmental upgrading.

Efficiency gains were made by a subsidy request to purchase advanced vision technologies to improve the distinguishing of bread types and their respective allergens. Efficiency gains in an environmental sense were seen in the instalment of PV panels to power the recycling machines.

Formalisation was seen as the marketing company was in the process of becoming a corporation. Recipes were standardised to allow for the standardisation of the concept of 'circular bread' as a preparation for expansion due to increased marketing and acquisition efforts.

Including marketing functions into the value chain led to economic upgrading, as acquiring new customers would introduce new, higher-margin products, allow for closer alignment of various supply chain functions, and incorporate more bakeries into the circular bread concept. Preference was given to abandon returning bread as chicken feed for eggs as bread was a higher value-adding activity.

The workers at the bakery adhered to a collective labour agreement and were paid a wage higher than the one specified in the agreement. The work schedule was mutually agreed upon, and the production of circular baked goods was mostly carried out during the day, which was unusual as baking was typically done at night.

Complexity of transactions

The complexity of this collaboration was high. The flow of unsold bread to the sourdough company processed 5000kg of unused bread per day, so numerousness was high. Variety was seen in ingredients and allergen composition heterogeneity due to variations in recipes employed by different bakeries. The variety of business activities differed between the parties operating in this collaboration, making them dependent on each other. E.g. the recycler was dependent on the flow of bread from the bakery.

Ability to codify transactions

The ability to codify transactions was high. Information about ingredients and specifically allergens had to be communicated between supply chain partners and production methods to comply with strict industry production standards based on food regulations. These production standards: Hazard Analysis and Critical Control Points (HACCP) allow for a standardisation and efficient information exchange between supply chain partners. Moreover, a list was used to predict future demands.

Capabilities in the supply-base

The capabilities in the supply-base were high as this collaboration satisfied customer demands. Customer demands were seen both in quality of the product as well as communication of CO₂-impact numbers, often required by customers like catering companies.

Conclusion

The complexity of transactions, ability to codify transactions and capabilities in the supply-base are considered to be high. This results in a modular value chain.

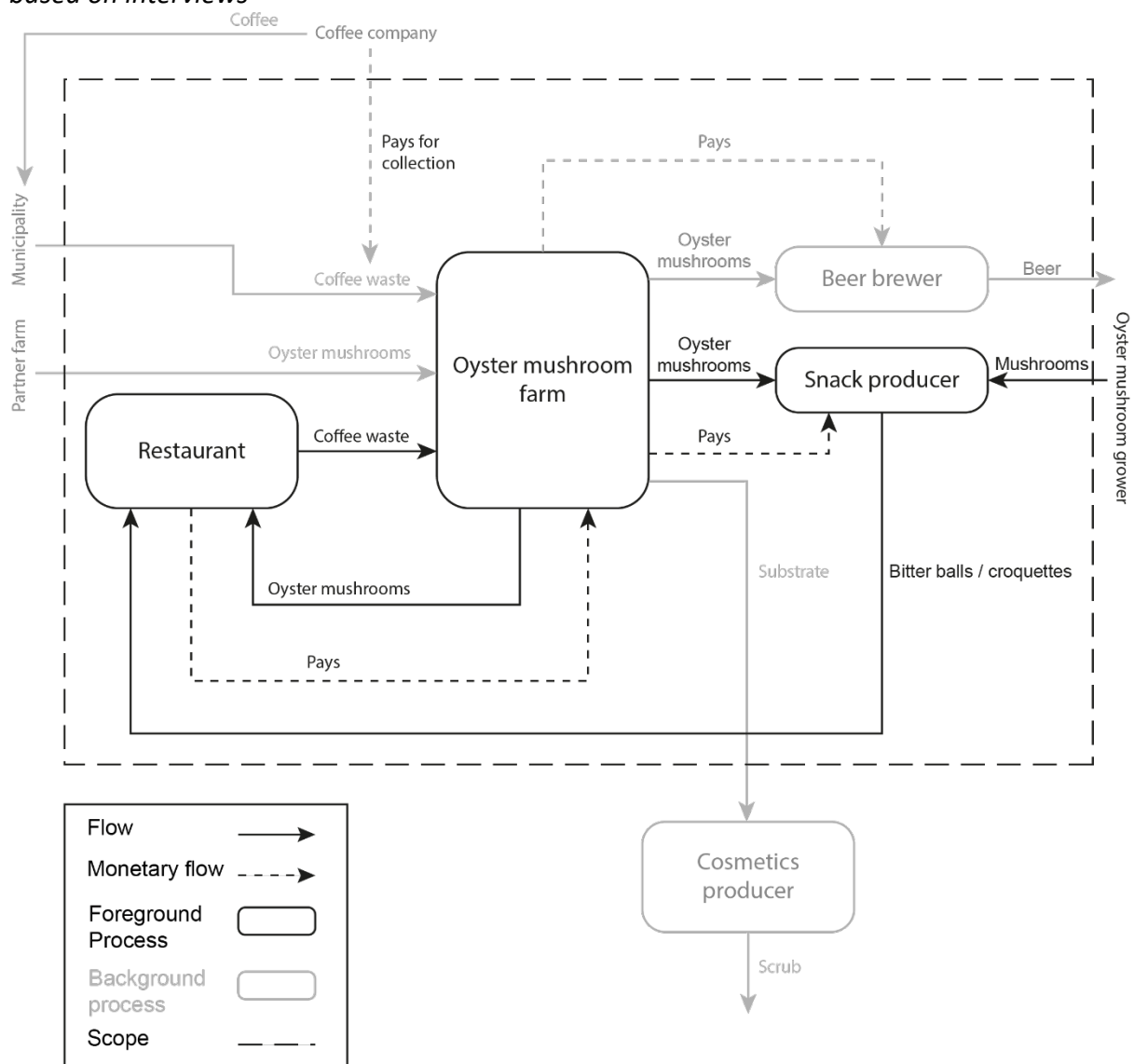
Oyster mushrooms, small (relational)

This circular supply chain was centralised around a one-person farm that grew oyster mushrooms on coffee waste collected from, amongst others, a high-end restaurant in the area that also bought oyster mushrooms and oyster mushroom-based snacks (figure 10). Products like vegan croquettes and bitter balls produced by a snack producer. Another oyster mushroom farm was partnered when its production was insufficient to supply the snack production. Both the oyster mushroom grower and restaurant employed people with a distance from the labour market. The farm employed them through the municipality, and the restaurant employed them through an external organisation.

The production capacity was around 20 kg of oyster mushrooms per week, with one batch taking 6 weeks to grow.

The restaurants that provided coffee waste were also obligated to buy the products, produced by the farm. The restaurant paid for the oyster mushrooms and snacks. The collection of coffee waste was free.

Figure 10. Circular supply chain of oyster mushroom grower (small) including monetary flows, based on interviews



The coffee waste had to be collected three times a week as it had to be fresh.

Moreover, it could not be contaminated with other waste, which posed a problem for the waiting staff in the restaurant sometimes, resulting in a failed harvest. However, no contracts were used in the studied collaboration. A self-fabricated stamp card was the only form of formalisation seen in the collaboration. No food safety documents were used, and the parties in the collaboration disagreed on whether they should be in place. In snack production, food standards were in place. The restaurant was satisfied with the products,

even though sometimes the harvest failed. This satisfaction was based on the locality and personal connection of the parties in the collaboration rather than the products' quality.

Locality, environmental upgrading, and social upgrading were found to be more important than economic upgrading, as the only economic goal was to make a living wage out of the collaboration. The circular oyster mushrooms and derived snacks were more expensive than the regular variant. Still, the restaurant was willing to pay more because of the personal connection, locality and sustainability efforts of the mushroom farm. This personal connection also resulted in knowledge exchange in developing deep-fried snacks to improve the recipe.

Environmental upgrading was seen in the oyster mushroom grower, which started a process of replacing electrical heaters with PV panel-powered heat pumps.

Complexity of transactions

The interdependency was high, as the oyster mushroom grower was dependent on the restaurant to provide coffee waste to grow oyster mushrooms on. The variability of returned coffee waste was high, as often it was contaminated. The variety was high, as the two parties were very different. Uncertainty was high as harvests sometimes failed due to contaminated coffee waste.

Ability to codify transactions

The ability to codify transactions was low. No contracts were used. Only a self-fabricated stamp card was the only form of codification. Food safety standards were not in use in the supply chain of oyster mushrooms. According to the farmer, it was not necessary because "it is an unprocessed product." The restaurant chef believed otherwise "I realize that

it's not exactly how it's supposed to be.”, said, which implies more rigorous food safety standards and procedures should have been in place. In the production of the snacks, food safety standards were in use but the snack producer quit operations.

Capabilities in the supply chain

The capabilities of the supplier, in this case, the oyster mushroom farmer, were high as their capabilities to produce oyster mushrooms on coffee waste were sufficient, even though sometimes harvests failed.

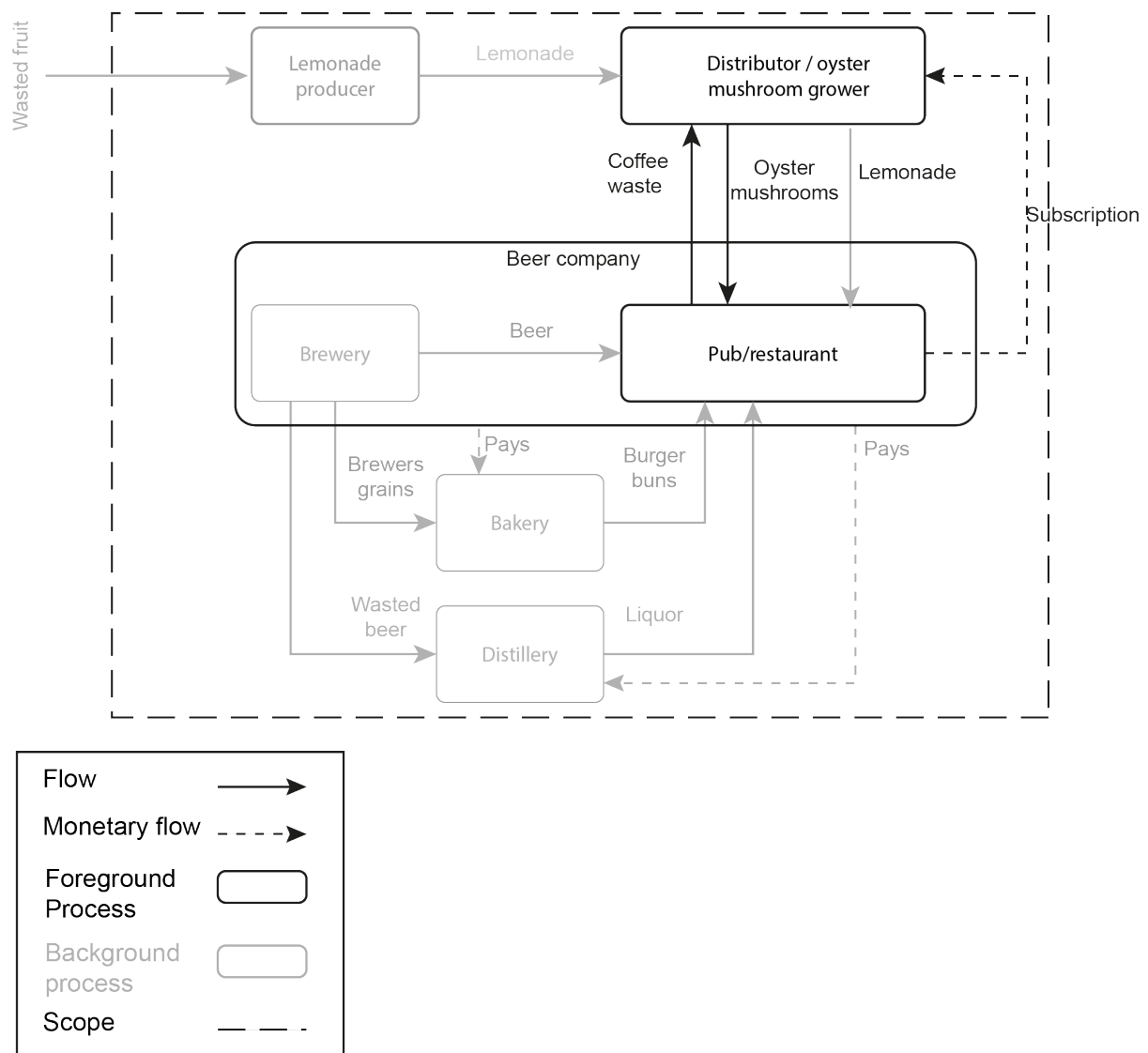
Conclusion

In conclusion, a relational governance type was found, based on high complexity of transactions, low ability to codify transactions, and high capabilities in the supply chain.

Brewpub oyster mushrooms (Captive)

This collaboration consisted of a microbrewery and a company that collected several waste streams to produce new food products but also acted as a wholesaler for other circular products, including lemonade made from waste streams (figure 11). The collaboration failed, as communication was lacking. Therefore, the brewpub stopped buying the mushrooms, however, due to contractual constraints, the collection of coffee waste was forced to continue. The collection of coffee waste was based on a paid subscription and the brewpub had to pay for the oyster mushrooms as well.

Figure 11. Value chain brewpub oyster mushrooms, own work based on interviews



This collaboration failed as there was no communication from the oyster mushroom grower. No instructions were given to the brewpub for collecting coffee waste in the provided containers, resulting in moulded, unusable coffee waste for the oyster mushroom grower. The brewpub could not cancel the contract when the oyster mushroom grower raised the service costs, so they had to pay for the collection even though they did not use the oyster mushrooms as the quality was not good enough. The oyster mushroom grower also acted as a distributor for other circular products but was unreachable in the evenings when the brewpub was open.

Labour conditions and wages in the brewpub were transparent and agreed upon by the staff and managers.

Complexity of transactions

The complexity of transactions was high. The interdependency of players in this collaboration was also high, as the oyster mushroom grower was dependent on the brewpub for coffee waste, and the brewpub was dependent on the coffee mushroom grower, as it was also the distributor for other products like lemonades used in the pub. The diversity was high, as the oyster mushroom grower sold a variety of products. The uncertainty was high, as often coffee waste was moulded and contaminated.

Ability to codify transactions

The ability to codify transactions is high, as the oyster mushroom grower worked with contracts. When the brewpub wanted to cancel the collaboration, it was not possible due to contractual obligations, resulting in unnecessary costs.

Capabilities in the supply base

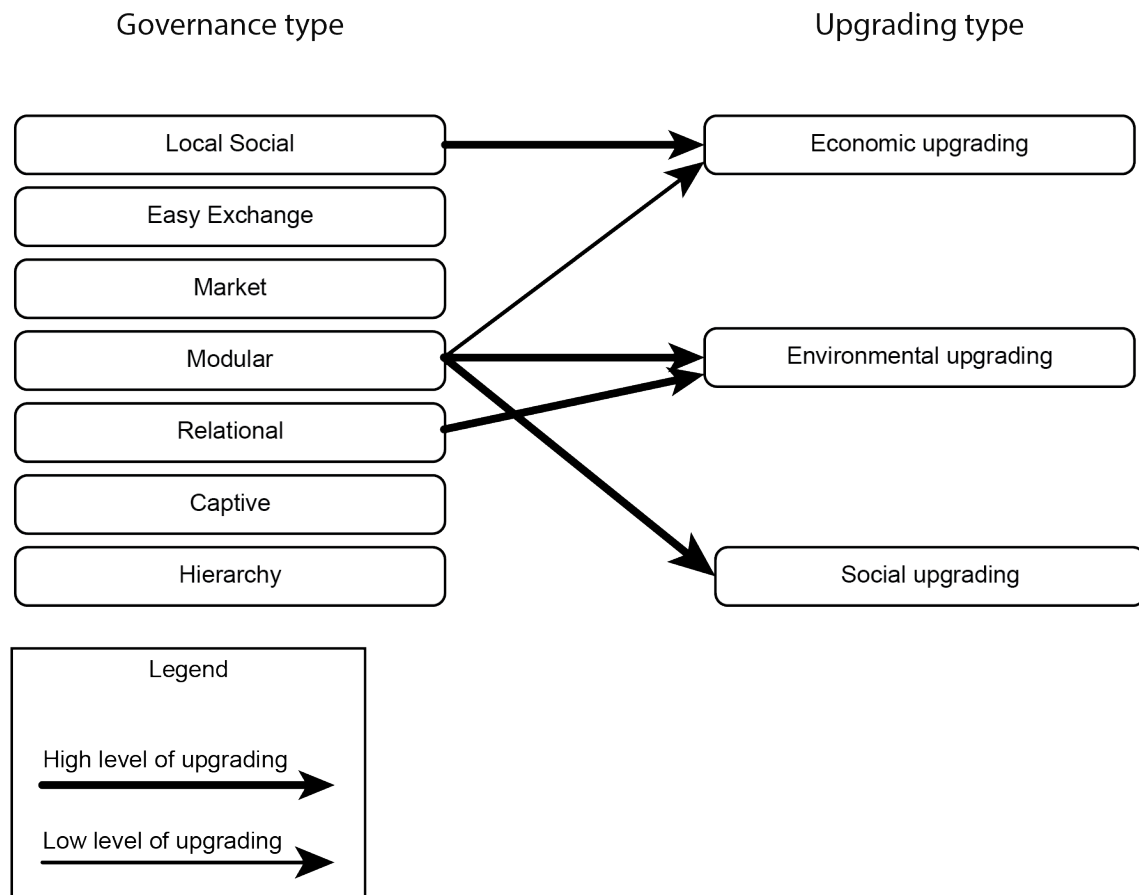
The capabilities in the supply-base were low as much of the collected waste wasn't used to produce oyster mushrooms, and the quality was sometimes lacking. Moreover, the distributor/oyster mushroom grower was not available outside office hours, when the brewpub was open.

<i>Oyster mushrooms (small)</i>	High	Low	High	Low	Low	Low	Low	High	Low
<i>Relational Brewpub oyster mushrooms</i>	High	High	Low	Low	Low	Low	Low	Low	Low
<i>Captive</i>									

Linking governance structure & value chain upgrading

This chapter will link the governance types to the supply chain upgrading. As illustrated in Figure 12, a Local Social governance type was associated with economic upgrading, a modular governance type was associated with all types of upgrading and a relational governance type was associated with environmental upgrading.

Figure 12. Link between governance type and value chain upgrading



Local Social

A Local Social governance type was associated with high economic upgrading. Product upgrading resulted from the collaboration's innovativeness in which all parties played their own part, from extraction to application of newly found ingredients. This product upgrading was sometimes the result of requests by external partners where the innovative and close-knit nature of the collaboration allowed for flexibility and adequate product development. Process upgrading was done to mitigate waste and costs. "For us, the circular value chain is obvious, but we also work with a lot of SMEs, so every gram that falls on the floor is lost money. So, on the one hand, it's intrinsic motivation, but it's also cold hard cash if a cart fails

in the oven.” Process upgrading was also seen in investment in more efficient machinery like new proofer machines.

The medium size of the collaborations allowed for functional upgrading through the integration of logistics activities. Branding/marketing and R&D activities were integrated from the get-go, facilitating rapid scaling. You could even argue that R&D companies ran these collaborations rather than food producers. “We are really are a research company, but that has since been scaled up to manufacturing the products.” Is what one of the companies said.

Intersectional upgrading was not seen in this governance type. No patterns were found for environmental or social upgrading.

Easy Exchange

No upgrading was seen for the Easy Exchange governance type, as one collaboration was examined, and it failed to make any sales or establish any kind of upgrading. The lack of sales was ascribed to a lack of marketing and the Dutch consumer not being ready for the specific product. “I should have done research on whether Dutch people are willing to switch from a land of pea soup and pancakes to cold soup. I never asked that question.” Is what the soup producer said. It can be concluded that there was a lack of capabilities in the supply-base as customer demands could not be met.

Market

In the investigated case, a collaboration operating a market governance type led to no form of upgrading. The market governance was characterised by a purely transactional relationship with little to no contact between the collaborating parties. “It also often changes

within such a restaurant, who is in charge of the food, chefs, the rotation of chefs changes all the time at restaurants at certainly at the larger chains so that contact is not super active either." Is what the oyster mushroom grower said about the relationship with the clients. You could even argue if this can be considered a collaboration in the first place, as no long-term, trust-based relationship was found.

Relational

Economic upgrading efforts of the collaboration operating the relational value chain were unsuccessful as no process, functional or intersectional upgrading was seen. The question remains whether this was the result of the governance type because the party central to this collaboration was not aiming for major economic upgrading. "I don't need to get rich from this but I do just want a salary out of it." The small oyster mushroom farmer said. Moreover, the collaboration was mostly run by one person, so the lack of economic upgrading could also be ascribed to size constraints.

The only form of upgrading was seen in environmental upgrading. This was based on product upgrading where a vegan variant was developed for a conventional deep-fry snack. The relational aspect of the collaboration allowed for easy knowledge transfer in the collaboration. No social upgrading was seen in the collaboration.

Modular

The collaborations operating modular value chains showed process upgrading and functional upgrading. One collaboration was run on a personal relationship, and the other on a transactional relationship. The collaborations operating this value chain were medium in size. Process upgrading was seen in efficiency gains in the mechanisation of product production processes, and functional upgrading was seen by the integration of marketing and

R&D activities in the collaboration. In one case, marketing activities were integrated from the get-go; in another, the integration of marketing activities in the collaboration led to scaling and expansion. The integration of R&D activities led to environmental upgrading as these collaborations now had the knowledge to produce more sustainable products. E.g. a loaf of bread that would mitigate cutting waste at the user. This product development was always done in collaboration with external partners. One party developed more environmentally sustainable products for specific clients: “What we now have developed is a farmer’s couple bread. That’s a loaf that slopes down much less so you have less cutting loss on the sides. Because yes, it’s already quite an expensive bread and if you take out, say, 20 slices, but those slices are much smaller at the ends, then yes, that’s a kind of cutting loss (...) For the customers, it is both [cost saving and environmental benefits] interesting because they don’t want to have a high cutting loss because of the waste, because, for example, big caterers who also monitor how much waste they produce, how much they throw away. So they don’t want that. Plus, you do indeed have a value increase because you get more slices out of your bread. So yes, the cost price per slice goes down.” Is what the bakery marketing company said.

The other party developed more environmentally sustainable products in collaboration with an external partner rather than for a specific partner. The cashew company about the valorisation of the cashew apples: “If we want to do something with it, then make a project for it. Then you also have to make sure there is budget for it and then you start working with local parties on that. So it is about the farmers, it is much more likely a local NGO will engage with them to work with them to solve this and that you start working with them to develop the solution that is in your head to develop that and then also to then get the flow of cashew apples going. Ensuring that it is ultimately a residual product which is ultimately processed.”

Social upgrading was seen to be done through the use of collective labour agreements where, in all cases, a premium was paid above the stated wage in the labour agreement. Labour conditions were also ensured through unions. In one company this was only done in the manufacturing company, in the other case, improving labour conditions was a collaborative effort of all parties.

Despite operating the same governance type, upgrading efforts were approached differently as outlined in the examples above.

Captive

The captive governance type led to no type of upgrading. Moreover, this governance type could be argued not to be a collaboration, as no long-term trust-based relationship was found.

Only one company was sampled as relational, easy exchange, market, and captive. Therefore, it was hard to establish patterns on how the different governance types led to value chain upgrading as different collaborations in the same governance type often established upgrading in different ways. Therefore, the next part of the analysis will shift its focus to the elements that constitute the governance types: (i) Complexity of transactions, (ii) ability to codify information, and (iii) capabilities in the supply-base.

Linking key determinants & value chain upgrading

In this section, the elements constituting governance types will be linked to the observed upgrading in the upgrading types.

(i) Complexity of transactions

Low complexity

Low complexity of transactions was seen in Easy Exchange, market, and Local Social type value chains. In the Local Social type, only one circular ingredient was used in the collaboration, which resulted in low complexity and allowed for product upgrading. This allowed for easier process upgrading by focusing on one production process and optimizing it with new machines. Functional upgrading was seen by integrating several activities like marketing and R&D. Because of the low complexity, resources could be allocated to these activities rather than developing ways to mitigate high complexity. Low complexity was also seen in Easy Exchange and Market governance types. However, little can be said about the relationship between low complexity and upgrading in these cases as these collaborations failed due to earlier mentioned factors.

High complexity

High complexity of transactions did not directly lead to any type of upgrading. If any, it hindered upgrading efforts. Knowledge exchange appeared to be critical to deal with complexity and a requirement for value chain upgrading. For this, two different ways were observed: (i) Knowledge sharing based on long-term relationships and (ii) codification of transactions. Knowledge sharing based on long-term relationships will be explained first, and codification of transactions will be explained afterwards.

Knowledge exchange based on long-term personal relationship

High complexity of transactions was associated with high process upgrading and high functional upgrading in modular value chains but not in relational or captive value chains. That was because of the different ways the different types dealt with uncertainty. This uncertainty arose in these value chains due to the providers' lack of knowledge in waste stream treatment. This was clearly seen in the different cases where oyster mushrooms were grown on coffee waste. In the captive governance type, the relationship was purely transactional. Knowledge transfer on storing and processing coffee waste was lacking, resulting in moulded coffee waste and one of the parties wanting to quit the collaboration. "They [the oyster mushroom farmer] said that only a very small part of the coffee grounds they collect meet the quality standards, so only a small portion is actually used to grow the oyster mushrooms." Is what the brewpub said. In the case of a relational governance type, the collaboration was run based on a trusted relationship: "There are very short lines, and she [oyster mushroom farmer] is very small, of course, she comes in regularly to pick up the coffee grounds, so yes, then then those lines are there naturally quite short. (...) I see her once a week like 'hey hello' say a little chat. And I think for business once a month or so." is what the restaurant chef said about the relationship with the small oyster mushroom grower. This personal relationship was the basis for knowledge transfer, resulting in improved harvests. He continued: "In the beginning, we also had a little hassle with the coffee waste. Because we are one big organisation, big company. We have a lot of people working and then of course someone throws in a sugar bag and the other one an ashtray between it. In the beginning, it did go wrong sometimes. She also did a few times have a failed harvest because there was contamination in it and I think that coffee waste can't be too old because then she can't grow anything on it anymore, so she comes at least two or three times in the week she comes here to collect the coffee grounds and we now put it in a sealed collecting bucket for her." Knowledge transfer was also seen in industry-

specific knowledge and during product upgrading where the oyster mushroom croquette was made fully vegan to increase sustainability: “Sharing knowledge by giving tips on how to improve the recipe of the croquettes. To give a small example, the manufacturer of the croquettes and packages was going to quit. And then I start tapping into my contacts if anyone has any interest in helping her further?” Said the chef. However, because the farmer was on her own, she had no time for any economic upgrading efforts but satisfaction was still high between the two parties.

High complexity of transactions was associated with environmental upgrading, except in a captive governance type. This resulted from a difference in levels of interdependency between the companies active in the collaborations. When parties depended on each other, knowledge was generously shared between the parties, facilitating product upgrading in environmental sense, e.g. the development of vegan snacks to replace meat-based alternatives. However, when there was a one-way dependency like in a captive governance type, no environmental upgrading was seen, as no information or knowledge was shared.

No patterns were found between the complexity of transactions and social upgrading.

(ii) Knowledge exchange through the codification of transaction

Codification of transactions was seen to facilitate value chain upgrading by facilitating knowledge transfer. In a market governance type, codification was seen in the use of order systems to facilitate transactions without any specific coordination “Especially at the bigger chains we see that contact is not super active either.” Is what the oyster mushroom grower

said. This transactional relationship, rather than an intensive collaboration, resulted in a lack of communal upgrading efforts.

In modular value chains, codification facilitated functional upgrading in the form of R&D activities. Codification was seen in the adoption of industry-wide food (safety) standards, which allowed for easier information sharing, constituting the framework for integrating R&D activities. E.g. the framework of the cashew grading system structured research into the valorisation of the lowest grade. “There are 29 different cashew grades and vast majority of those we put in our pouches, but there are very small portion, a kind of grit. You can't put that a bags that just not recognisable as a cashew. (...) we buy everything that comes from the factory so also the grit. And the consequence is that we have to do something with the grit, because we can't put it in a bag anymore and so in that way we have to find new uses for that. For example ice cream and cheese.” Is what the cashew company said. In the circular bakery, codification was seen in the standardisation of recipes needed for the development of the product into a standardised concept that enabled scalability and marketability. “We are formalising a bit more, because we want to connect several bakeries to this concept and then of course it is very good to make certain basic agreements. So okay, if we're talking about circular bread, then it has to meet these requirements. And these are the rules that we set, so we're at a stage where we're defining more because of course it's going to help us that we're doing this now with a small group, then later on with a big group.” Is what the bakery marketing company said. In both examples, R&D was facilitated by codification, resulting in easier information sharing with external partners outside the direct value chain, like NGOs and knowledge institutes, who were part of the product upgrading process. “If we want to do something with it [valorisation of the cashew apple] we create a project for it. Then you also have to make sure there is budget for it and then you start working with local parties on it. So

that's the farmers, it is then a local NGO. We will engage with them to work with them to solve this and that you start working with them.”

Codification was associated with high environmental upgrading in modular governance types. This was the result of process upgrading. The codification of transactions facilitated information sharing, which was needed to organise the value chain efficiently and to reorganise activities in a more environmentally friendly way. E.g. abandonment of lower value activities like the use of returned bread as chicken feed or the stimulation of the use of cashew apples rather than letting them rot in the sun. Moreover, in some instances, codification was seen to stimulate product upgrading in the environmental sense. In the case of the bakery, the codification of sustainability KPIs by the customer stimulated the development of more sustainable products mitigating waste.

In a captive governance type, codification in the form of contracts was considered a burden imposed by the dominant party. The long-running contracts were viewed as restricting rather than stimulating upgrading efforts, making switching to a new partner costly for the weaker party when the dominant party lacked sufficient capabilities.

Low codification

There was no need for codification in partnerships that were based on trust. This was observed in Local Social value chains.

The innovative capabilities in these collaborations required no codifications as partnerships were long-running and based on trust. “I have to say there, we work a lot with contracts. Of course, you always have a few more [companies] and those are usually some smaller ones. Companies that we've been working with for a bit longer. Yes, it's a bit more

informal with those but you already have a relationship with them and then you know what you can expect from each other from that history so then you don't always pour it into a contract." Is what one of the ingredient producers said about the relationship with smaller, innovative companies. This informal, personal relationship allowed for the collaboration's innovativeness because of the speed they could act, resulting in high levels of product upgrading. The same actor: "The innovative capacity. By this, I also mean the speed at which a company can act. You can imagine that in terms of speed, the larger companies of this world really are behind on smaller, innovative companies. Yes, those are maybe in terms of volume in terms of transactions very interesting, but that also requires a long-term approach and so is a bit less interesting in terms of speed and innovativeness."

For functional upgrading, additional functions like marketing/branding and R&D activities were already present from the get-go. For the integration of logistics however, low codification was seen, as this was also done in a trust-based personal manner: "We have a driver who just drives around here. He was just here, he just brings a product around also to the brewery then so that's just everybody knows driver Perry, Everybody knows him."

(iii) Capabilities in the supply-base

High capabilities in the supply-base were associated with economic upgrading in a Local Social and in a modular value chain. The satisfaction of customer demands was established by primarily focusing on excellent taste and quality of the product. Moreover, catering companies increasingly demanded that producers of food products provided numbers of environmental impact. Especially catering companies catering to governmental institutions were obligated to provide these numbers as a result of the government's sustainable procurement policies. The interviewed catering companies also stated that in the

future, all food companies have to submit these numbers in order to be included in the product range, also for companies not catering to the government.

High capabilities in the supply-base were associated with environmental upgrading in modular and relational governance types. The environmental upgrading was a result of product upgrading, resulting in products that were more sustainable than the original product, either by mitigating waste or by causing less environmental impacts in the production of the new product. This product upgrading was successful because of the earlier mentioned focus on taste and quality during the product development. For instance, customers requested a new shape of bread loaf to reduce cutting waste or a vegan snack as an alternative to meat-based products. "And ideally, of course, I would like the snacks to be vegan too, but look. When I started with those bitterballs and croquettes, they were only vegetarian and I was like: Well, I think that's actually enough. I'm not vegan myself, I'm also, even I'm not a diehard vegetarian. But I did get more and more demand for it because I'm also more often at festivals and events and stuff. So then I sat down with my producer. Like yo is it doable without detracting from the taste. That worked out, so those croquettes and bitterballs are vegan." Is what the small oyster mushroom farmer said.

Low capabilities in the supply-base were associated with a lack of all types of upgrading as a result of the failure of the collaboration altogether. I.e. high capabilities were necessary but did not establish value chain upgrading by itself.

Discussion

This study analysed how circular food collaborations governed their value chains to reach economic, environmental and social upgrading. The analysis focussed on how different governance types did this after which the connection was made between upgrading efforts and the underlying elements constituting the governance types: Complexity of transactions, ability to codify transactions, and capabilities in the supply-base. This section will start with discussing the newly found governance types, after which the link between governance types and the value chain will be compared, then the constituting elements will be discussed and lastly, limitations, scientific contribution, and managerial implications will be given.

Discussion findings

Here, the results will be discussed.

Governance types

The governance types described in the theory on global value chains result from a combination of three elements: Complexity of transactions, ability to codify transactions, and capabilities in the supply-base. When scored high or low, eight different combinations are possible, from which five were previously found in practice (Gereffi et al., 2005). The GVC theory is built on the premise of linear value chains on a global level where value chains are fragmented and spread worldwide (Gereffi et al., 2005); however, this study focused on the empirical context of local collaborations revolving around circular value chains, where information sharing is often facilitated by physical proximity and associated personal connections of value chain actors. The choice for GVC theory has been made because it looks at the value chain from a broader view than what is seen in SCM-theory, which focuses on

buyer-supplier relationships. SCM-theory was not suitable for this research because, as mentioned in the theoretical framework, collaboration between several value chain partners is essential for mitigating food loss and building a circular supply chain in the food industry.

The different empirical contexts explain why two governance types that are not previously known in GVC literature have appeared: the Local Social governance type and the Easy Exchange governance type.

The Local Social governance type (Low complexity, low ability to codify transactions, and high capabilities in the supply-base) has not yet been seen in GVC literature, which served as the basis for this research. Low complexity is only seen in combination with a high ability to codify transactions in the market governance type. There, low complexity requires high codification because transactions are purely price-driven and the cost to switch partners is low (Gereffi et al., 2005), whereas low complexity in the Local Social context is associated with low codification as transactions are collaboratively driven, and the parties trust each other due to long-running relationships. The empirical context of the circular economy in the food industry might explain why the combination of low complexity and low ability for codification is viable. In CE literature, the focus on the locality of this governance type has been seen to be important for building a circular agrifood-systems: “The transition to a fully circular economy will require a paradigm shift—another agricultural revolution—the transition away from large-scale industrial agriculture to a decentralised network of circular food systems.” (Liaros, 2021; p. 1193) This can be seen in this newly found governance type where locality played a major part in information sharing and upgrading efforts.

The Easy Exchange governance type (low complexity, low ability to codify transactions, and low capabilities in the supply-base) is also not seen in GVC theory. Low capabilities in the supply-base are only seen in value chains with top-down governance from a powerful lead

firm like the hierarchy governance type, which integrates all steps in the value chain within one company (Gereffi et al., 2005). In this case, this integration into one company is clearly seen where several production steps are formed into one company. However, the difference with a hierarchy governance type is that the supply of the waste stream is not integrated. The context of the circular economy in the food industry might explain why the difference is seen with GVC-literature. The novelty of circular food chains means companies experiment with how to run these collaborations. The collaboration in this governance type was a start-up which did not yet sell products. Moreover, efforts to break into retail were unsuccessful. More research should be done on whether this governance type is viable at all or factors like consumer-readiness are of major influence.

Value chain upgrading

In GVC theory, value chain upgrading is studied from a view of globalisation (Golini et al., 2018; Milberg & Winkler, 2011), focusing on economic and social upgrading in developing nations, and measurements of value chains upgrading are done on country, sector or firm level (Milberg & Winkler, 2011). Quantitatively, the link between value chain governance and upgrading has been studied in assembly industries, where the relationship between governance type and upgrading was studied in the relation between the supplier and customer (Golini et al., 2018). In this study, however, value chains are studied on a local level in a circular context where a clear buyer and supplier cannot be identified, as firms are often both. Therefore, the analysis was done on the level of the collaboration, which explains why the results did not agree with GVC-literature. This choice was made because of the importance

of collaboration for establishing circular value chains to mitigate food waste (Viscardi et al., 2022).

Different forms of value chain upgrading have been found in the different collaboration. Product, process, and functional upgrading have been found for economic upgrading. No intersectional upgrading was seen. Whenever one of these kinds of upgrading was seen to mitigate either waste or environmental impacts in the production process, it was classified as environmental upgrading, similar to other studies (Golini et al., 2018).

Social upgrading was also seen, however, this was often on the level of the individual firm rather than on the level of the collaboration. These findings were expected as the a priori codes were derived from the existing literature. GVC theory this paper is based on solely focuses on workers' rights. Whereas, results of this paper suggest that circular food collaborations also make a social impact beyond the direct value chain. E.g. creating financial independence for women in the cashew case. However, future research should focus on how social impact can be made on the level of the collaboration, rather than in individual firms, and how these collaborations can make a social impact beyond the direct supply chain. An example of a string of literature could be the use of CSR methods or certifications. Examples are adoption of CSR methods in Italy's circular agrifood industry (Fortunati et al., 2020), or adoption of B-corp certification in the recycling industry. The latter coins the "social recycling" path as a promising option for integrating social sustainability in CE practices for different stakeholders (Poponi et al., 2019), which would be worth while exploring in the context of circular food collaborations.

Governance types and value chain upgrading

Value chain upgrading was lacking in the Easy Exchange governance type. According to the food processor, this was because research was never done on consumer preference for the product and there was a lack of marketing efforts. This is in line with CE literature, as a lack of consumer interest is generally seen in adopting of the CE in the EU (Kirchherr et al., 2018). Moreover, marketing the CE is difficult as overcoming consumer factors like contamination, disgust, and newness need special communication strategies (Chamberlin & Boks, 2018).

Value chain upgrading of the Local Social governance type has not been described in the literature as this governance type is not yet known. However, similarities can be seen in what is traditionally seen in modular value chains. Value chain upgrading is largely based on technical innovation (Gancarczyk et al., 2017b) and product upgrading based on client requests (Gereffi et al., 2005). E.g., developing a new bread loaf shape to mitigate cutting waste in catering companies. The difference however, is that the innovativeness of this governance type results from the lack of codification which allows for speed and flexibility. As mentioned earlier, collaborations are run explicitly without the use of contracts.

This study saw process, functional, environmental and social upgrading in modular value chains. Case studies of value chain upgrading in the electronics industry show that product, process, and functional upgrading result from a firm's ability to introduce new electronic product innovations to the market. These innovations deliver service-intensive activities to the needs of a specific customer (Gancarczyk et al., 2017b). This was clearly seen

in the case of the circular bakery, where high process upgrading was seen in which every affiliated bakery got its own recycling machine and process.

Market governance did not lead to any value chain upgrading in this paper as no collaboration was seen. A case study on vegetable farmers shows that collaboration in a market governance is a viable governance type to operate, as long as producers are formalised in a Producer Organisation (PO). This PO is able to make contract agreements with buyers. These contracts minimise transaction costs through mitigating monitoring costs. Quality requirements can be set in contracts, forcing the producers to produce higher quality products and receive a higher price through ex ante agreed prices (Widadie et al., 2021) resulting in economic upgrading.

Literature on relational value chains states that the strong link between the parties in this governance type facilitates knowledge exchange, which is associated with product and process upgrading (Golini et al., 2018). This mechanism was clearly seen in product upgrading when the restaurant chef helped with the development of the oyster mushroom-based snacks, and process upgrading was seen when the oyster mushroom farmer helped prevent the pollution of coffee waste in the restaurant to improve harvests.

The captive governance type was not seen in this study. However, this governance type is not uncommon in the food industry. For producers of food products this governance type can ensure market access in the short run but in the long-run the producer will not have any voice in decision making nor claim of any (economic) benefits as the lead firm can change or even break the relationship at any time at its own convenience (Carbone, 2017).

Quantitative literature shows that captive governance from the supplier side results in process, functional, social and environmental upgrading. From the customer-side captive governance results in product, functional, and social upgrading (Golini et al., 2018). A captive

governance type facilitates knowledge exchange, which results in product and process upgrading. However, in this study, the captive governance type saw a lack of communication on storing and processing coffee waste, leading to the collaboration failing altogether.

The two newly found governance types are low in complexity, which is surprising as different strands of literature suggest that circular food chains are more complex than linear value chains. This comes from research on food webs (Knorr & Augustin, 2021) and circular business models (Hopkinson et al., 2018). Moreover, research into the system dynamics of circular supply networks categorises circular supply chains as the most complex supply chain category (Braz & de Mello, 2022). More research should be done on how these governance types fit into these other strands of literature that seem to reflect the opposite of the findings in this paper. To mitigate complexity, information sharing could be the answer. This is viewed as crucial for building circular food chains: Traceability and transparency are required from all players in the value chain to guarantee food safety. Therefore, information hiding should be eliminated, and information sharing should be facilitated (Kumar Mangla et al., 2021). The importance of information sharing is in line with this paper's findings where successful value chains shared information through codification or trust-based relationships. An avenue worth exploring is the use of IT in facilitating information sharing as using IT could enhance codification efforts and thus mitigate complexity. This is often categorised as functional upgrading (Burger et al., 2018). However, this form of functional upgrading faces many barriers: technological innovations & lack of eco-innovation, technological immaturity, high investment costs, resistance from old business models, lack of skilled technical people, and lack of technology infrastructure. These barriers could be investigated in how to overcome these barriers (Kumar, A. et al., 2022).

Production of high-quality products and the ability to provide CO₂-impact numbers were considered capabilities in the supply-base. These capabilities are, amongst others, recognised as critical success factors for circular business models valorising agricultural waste and by-products “Traceability, high-quality standards and fair agriculture attract clients even if the products have a higher price than conventional ones” (Donner et al., 2021; p. 6). More research should be done on whether the, in the study stated, 88 success and risk factors also apply in the valorisation of waste and by-products in the use stage of the product and how this influences the capabilities in the supply-base in circular food collaborations.

Limitations and avenues for further research

External reliability was hard to establish as qualitative research design makes it impossible to ‘freeze’ a social setting and the circumstances of a study (Bryman et al., 2008), especially the setting of the studied collaborations in this study as many of the collaborations were changing and developing at a rapid pace. This is expected to have a big effect on the results. For example, the gazpacho producer was considering producing a different product, changing the business model.

Only a limited number of cases were sampled, as the valorisation of lower-value food streams for human consumption is a novel field, and few companies were willing to cooperate in this research. A higher amount of collaborations would increase the internal validity of this study, as patterns could be better established and aggregated into a theory. However, this is expected to have little effect on the results as common patterns were still able to be seen in the analysis of the complexity, codification, and abilities in the supply-base.

As mentioned earlier, the theoretical framework used in this study was developed to study the governance of value chains on a global level in a linear context. The collaborations

studied, however, almost exclusively operate on a local level. Therefore, other lines of theory can add new perspectives, like the framework for supply chain collaboration in the agri-food industry (Matopoulos et al., 2007) or frameworks for supply chain analysis in the circular economy (Calicchio Berardi & Peregrino de Brito, 2021). Moreover, this study only looked at the governance perspective of the value chain. However, there are many more factors influencing economic, social, and environmental upgrading. These should also be assessed through other lines of research like theories on circular business models (Shekarian, 2020) or innovation systems (Pietrobelli & Rabellotti, 2011). Also, further research should be conducted on what drivers and barriers facilitate or hinder further upgrading efforts as it is unclear what other factors influence the effectiveness of upgrading efforts, E.g. the legislative constraints. To ensure transferability, this study could be replicated in different industries where local circular value chains are present to see whether the learnings of this study can contribute to CE governance in general.

Lastly, the Easy Exchange governance type requires further investigation as to what extent this governance type is viable, as only one collaboration was seen to operate this governance type, which was unsuccessful in establishing any type of upgrading.

Scientific contribution

Value chain upgrading by itself is studied quantitatively on the level of country, sector or firm (Milberg & Winkler, 2011). This study developed new measurements on the level of the collaboration . E.g. by incorporating systems theory in assessing complexity. This study contributes to value chain theory by empirical theory building through linking the concepts of governance types and value chain upgrading in a qualitative manner. This linkage has been studied quantitatively in the assembly industry on the level of the relationship between buyer

and supplier (Golini et al., 2018). This study contributes by adding a new level of analysis on collaboration-level. This is important as it contributes to the theoretical notion of value chain collaboration in order to mitigate food waste. The setting up process of these collaborations has been described in food packaging, but this research adds a perspective on the governance of the value chains producing food products themselves and how they are run in the long run.

The discovery of two new governance types, and a governance type not earlier seen outside of the electronics sector, adds new insights into how to design collaboration in the food industry in the context of a local, circular value chain.

Traditionally, value chain upgrading was only focussed on economic upgrading (Gereffi, 2019). This study, however, incorporates a new stream of value chain upgrading in an environmental and social sense and by doing so, this study integrates notions of sustainable development through the inclusion of sustainability in an economic, environmental and social sense. The latter is the most important contribution to the empirical context of circular value chains. Despite receiving more attention in CE research, social sustainability is often neglected (Padilla-Rivera et al., 2020) For the literature on circular food systems it adds a governance perspective on how the governance of circular food chains can contribute to growing economic sustainability, mitigate environmental impacts and improving social sustainability for workers.

Managerial implications

An important learning for managers is the way different collaborations mitigate complexity and thus facilitate information and knowledge exchange. When the complexity is low, a local social governance type is recommended in which relationships are built on trust, rather than high formalisation. This facilitates innovativeness. Together with high-quality

products and the ability to provide impact numbers, this governance type was associated with high economic upgrading, which can result in environmental upgrading. When the complexity is high, it is recommended to codify transactions in order to facilitate economic upgrading through technological innovation. This technological innovation allows for scaling and product development based on client requests which is associated with economic and environmental upgrading. Social upgrading should be done on a firm level through standardised labour contracts and unionisation.

Conclusion

This study aimed to answer the question 'How does the governance of circular food collaborations relate to value chain upgrading in The Netherlands?' Based on qualitative research, it can be concluded that a Local Social governance type is associated with high economic upgrading, a modular value chain is associated with a moderate level of economic and strong environmental and social upgrading, and a relational governance type is associated with high environmental upgrading. When looking at the underlying elements that constitute the governance types, it can be concluded that high capabilities in the supply-base are vital for facilitating value chain upgrading but it cannot guarantee value chain upgrading by itself.

The ability of a circular food collaboration to achieve economic and environmental upgrading is dependent on the interplay between its complexity and its ability to deal with that complexity. In cases of low complexity economic value chain upgrading is achieved due to the innovativeness as a result of low codification and the associated speed and flexibility of the collaboration. In cases of high complexity, economic value chain upgrading is facilitated by mitigation of complexity either based on codification or knowledge exchange based on long-term personal relationships. Environmental upgrading is the effect of economic upgrading in

which new products and processes are developed that either mitigate negative environmental impacts in the production process or mitigate waste in the consumer's use stage. Social upgrading is seen in the form of standardised labour standards and unionisation. However, this cannot be ascribed to the collaborations but happens on the level of the firm.

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Acknowledgements

I am extremely grateful to all the interview participants who were so willing to cooperate in the interviews and share their knowledge so generously. Moreover, I would like to express my deepest gratitude to my supervisor Maryse Chappin, without whom, I could not have completed this master's thesis. Her willingness and flexibility in personal rough times was of great help and her knowledge was truly inspiring. I would also like to thank my second readers Agni Kalfagianni and Iris Wanzenböck for their time grading this thesis.

Lastly, I would like to thank my friends, especially Yannick Speetjens, and parents for supporting me in this journey and keeping my spirits up high during this process.

Appendices

Appendix I Scoring upgrading

Circular cookies

Economic upgrading

Product Upgrading

The product development within the processing company was conducted in two directions: Firstly, the process of extracting ingredients from the organic waste was developed in collaboration with knowledge institutes, and secondly, the application of these ingredients was developed in collaboration with clients. E.g. the cookie company collaborated in the development of a new kind of fibre. The processing company preferred small innovative companies for this process over big incumbent companies. When product development was complex, the processing company and bakery would work together in product development. The cookie company had a standardised dough based on return bread in which the new ingredients would be tested.

Process upgrading

The processing company wanted to expand abroad to be closer to the source of organic waste, also increasing knowledge exchange with the farmers. Moreover, efforts were made to process more kilos of organic waste per hour. Efficiency gains were made by combining orders and decreasing lead times in collaboration with logistics companies. For the cookie company, efficiency gains were rooted in sustainability but also cash.

Functional upgrading

Marketing efforts were made by the processing company to target new customers for both companies.

Intersectional upgrading

The processing company experimented with other organic waste to extract ingredients.

EconU scoring

Economic upgrading was seen to be high. Product upgrading was especially high as the processing company was in essence an R&D company growing to a processing capacity of 30,000,000 kilotons of organic waste per day within 6 years. The cookie company knew how to tap into a market of sustainable cookies and company gifts.

Environmental upgrading

The environmental goal of both companies was the valorisation of waste streams. For the processing company, saving CO₂ was the main goal and the cookie company also hoped to inspire consumers to treat their food waste more sustainably. Moreover, the cookie packaging is plastic-free. Both companies had a common goal of achieving sustainability, but they used economic incentives as the driving force to reach their objective.

Product Upgrading

The cookie company developed a line of circular cookies in which the main ingredient is recycled bread.

Process upgrading

The processing Company stimulated electrical driving, taking the train for business trips, waste separation and sustainable office furniture. Moreover, the company explored wind energy to power its operations. However, wind energy was found to be more expensive and in conflict with offering a circular product in the market at the lowest possible price.

Functional upgrading

Functional upgrading to mitigate climate impacts was not seen.

Intersectional upgrading

Intersectional upgrading to mitigate climate impacts was not seen.

Scoring EnvU

Environmental upgrading was considered to be high as a completely new cookie line was developed based on circular ingredients. For the processing company, environmental efforts came as a result of economic efforts. "Sustainability is our core business. However, economic success is your right of existence." Is what the company said.

Social upgrading

In the collaboration specifically, no social upgrading was seen. "Playing chess on an economic, social and environmental board is hard to do. Especially in social sense." Is what the processing company said. However, a big difference could be seen in the deployment of people with a distance to the labour market. Where the processing company had its program for the deployment of people with a distance to the labour market and status holders, the cookie company found the deployment of people with a distance to the labour market "very upsetting" as it would only be done to save on labour costs.

The people working in the bakery were employed through a collective labour agreement and were often visited by the cookie company to check up on how things were going. The processing company stated to have good fringe benefits. In the bakery, labour guidelines and certifications were implemented, and female employees were hired. With other partners, labour conditions were trusted upon. For both parties, social impact was seen as a means to inspire consumers. However, social upgrading was not a priority nor was it something actively acted upon, therefore it was scored as low.

Gazpacho from 'B'-quality vegetablesEconomic Upgrading

The 'B'-quality produce would normally be downgraded to animal feed but The farmer also benefits from selling the 'B'-produce.

Product Upgrading

The concept of turning leftover fruits and vegetables into gazpacho was developed by students but no further product development was conducted.

Process Upgrading

Process upgrading was not seen in this collaboration.

Functional Upgrading

Functional upgrading was the biggest hurdle for this collaboration. The collaboration tried to target retail but marketing was seen as expensive and some efforts were made on social media marketing however, this turned out to be unsuccessful as sales were still lacking.

Intersectional Upgrading

Other options were explored to recycle old foodstuffs into new products for human consumption: Turning old bread into 0.0 beer and sweet potatoes into bread.

Conclusion

The economic upgrading was seen as low, as only one product was developed that did not sell.

Environmental Upgrading

The main goal in terms of environmental sustainability was to reduce food waste. No further environmental upgrading was seen in this collaboration.

Social upgrading

The collaboration was considering a collaboration with the food bank and considered employment of people with a distance to the labour market in the future but no further social upgrading was seen.

Oyster mushrooms (big)

Economic upgrading

Product Upgrading

Product upgrading was seen in collaboration with a snack producer that upgraded the oyster mushrooms in deep-fried snacks like bitter balls and croquettes. This resulted in higher margins. However, competing snack firms were able to make vegan snacks at a lower price point.

Process Upgrading

Because a big part of the incoming coffee waste was contaminated, pasteurisation was needed to overcome unnecessary labour, time and costs, however, this would have required building a new factory. Potential efficiency gains were also seen in logistics, sorting, quality control, growing and harvesting processes.

Functional upgrading

Marketing was provided by the municipality which sent international press to the oyster mushroom grower which created free PR.

For logistics, the grower charged a fee, however, in the future the grower would want to pay the places where it collects the coffee waste as it sees coffee waste as a raw material.

Intersectional upgrading

The oyster mushroom grower created additional business activities by engaging others to also grow oyster mushrooms on coffee waste. The company produced grow-it-yourself kits for consumers and hosted workshops to train entrepreneurs to start a similar business.

Conclusion

Economic upgrading was scored as high, as the grower upgraded oyster mushrooms into higher margins, efforts were made to optimise the efficiency to overcome contamination, and a major part of the business consisted of operations outside of the direct supply chain.

Environmental upgrading

Product Upgrading

Product upgrading regarding environmental sustainability was not seen in this collaboration.

Process upgrading

Collaboration with knowledge institutes led to research on the use of substrate as a fertilizer. The results showed potential for success, but current legislation restricts its use for this purpose. Additionally, ensuring proper fertilization application with substrate was challenging. Despite the barriers, an experiment was conducted.

Functional upgrading

Functional upgrading regarding environmental sustainability was not seen in this collaboration.

Intersectional upgrading

Intersectional upgrading regarding environmental sustainability was not seen in this collaboration.

Conclusion

Efforts were made to use used substrate as fertiliser however, due to regulatory constraints, turned out to be impossible. Therefore, the environmental upgrading was classified as low.

Social upgrading

The oyster mushroom grower employed people with a distance to the labour market for the production of the grow kits and the grower expressed their wish to only employ people with a distance to the labour market in a new factory. However, they also expressed concerns regarding efficiency gains with new pasteurisation steps as that would lead to job losses. In conclusion, the social upgrading was scored as high, as the new factory would only employ people with a distance to the labour market.

Cashews

Economic upgrading

Product Upgrading

Product upgrading was not yet seen. The company existed for only one year so only one product was introduced. However plans were made to also develop products from the lowest cashew grade. I.e. the cashew dust. R&D was conducted to develop cashew based cheese and ice cream however, these were not yet introduced to the market.

Process Upgrading

Process upgrading was seen in the factory in Tanzania where manual labour was replaced with mechanisation.

Functional Upgrading

As mentioned, R&D was integrated. Marketing activities were conducted from the get-go by the cashew company in The Netherlands.

Intersectional upgrading

Intersectional upgrading was not found.

Environmental Upgrading

A collaborative project was started to also valorise the cashew fruit that is normally left on the ground after harvesting. This emits a lot of NO₂ which is bad for the environment. This project was conducted in collaboration with an NGO and local knowledge institutes.

Conclusion

The environmental upgrading was considered to be high as major steps were taken to valorise several other waste streams in this collaboration.

Social upgrading

The wages of workers in the factory in Tanzania, as well as the farmers, were improved drastically as the Dutch cashew company paid a living wage. Working conditions were governed through a collective labour agreement as well as through unions. Factory workers were mostly female. The Dutch cashew company helped them open their own bank account as often their hard earned money was taken by their husbands. This way, the women gained financial independence. Because of these factors, the social upgrading was considered to be high.

Circular bread

Economic upgrading

The main goal of economic upgrading found was upscaling. To do so, a collaboration was started with a marketing and sales company that was in the process of becoming a bakery corporation.

Product Upgrading

Product upgrading was seen to be conducted through product development, often to satisfy specific customer demands. The development process was based on own knowledge, knowledge sharing with supply chain partners and collaborations with knowledge institutes. The close and personal relationships between the supply chain partners allowed for easy knowledge transfers and were seen as necessary for the development of higher margin products such as kvass, granola and pita rolls. Because all parties in the supply chain had a background as a baker, knowledge transfer happened efficiently and in a personal manner.

Process upgrading

Process upgrading was mostly seen within the sourdough company in which new production technologies were considered to improve efficiency for the expected increase in customer demand as a result of marketing efforts by the marketing company. The management of food safety regulations was seen as an area where efficiency could be improved and advanced vision technologies were considered to distinguish bread types and their respective allergens more efficiently. Furthermore, the bread recycler aimed to develop a newer and more efficient recycling machine.

Functional upgrading

To scale, new functions were absorbed into the value chain in the form of marketing and sales efforts. A collaboration was started with a marketing and sales partner which became responsible for the acquisition of new customers like B2B-catering companies.

The acquisition of these new customers would allow for the push of new, higher-margin products. The marketing and sales company was in the process of transforming into a corporation by incorporating several baking companies and formalising Circular Bread as a product marketed towards B2B clients like catering companies. This integration would allow for tighter integration of several supply chain functions and the addition of more bakeries into the circular bread concept.

Intersectional upgrading

Intersectional upgrading was not seen in this supply chain.

Scoring EconU

The level of economic upgrading was considered to be high because of the high degree of product development branching into several products, not only bread. Moreover, major developments were planned to increase the efficiency of production through the implementation of novel bread identification technologies and the in-house development of new recycling machines. The collaboration with the marketing company, and the future forming of a corporation, would result in a major gain in efficiencies and allow for scaling, contributing to a high degree of economic upgrading.

Environmental Upgrading

Circularity was identified as the primary goal of sustainability efforts. Moreover, preference was given to ways of preserving as much value as possible. E.g. The loop in which old bread is used as feed for chicken was aimed to be phased out in favour of recycling returned bread into new bread. However, the interviewees believed that to achieve environmental upgrading, it was important to focus on economic upgrading efforts first. To

reduce environmental impacts, it was deemed necessary to mitigate costs and scale up eco-efficient production methods, to make them applicable to industrial bakeries as well.

Product Upgrading

Product upgrading efforts were seen to be done based on the specifications of the client. Because catering companies monitored food waste, a new shape of loaf was developed to mitigate cutting waste. Also, efforts were made to mitigate packaging use.

Process upgrading (eco-efficiency)

The baking company reported significant efficiency gains by collaborating with the sourdough company. Before the collaboration, the baking company recycled returned bread into animal feed. The collaboration with the sourdough company allowed the baking company to access new technologies and retain more value with their waste streams. This move was considered to be more eco-efficient as it scored higher on Moerman's ladder.

Efficiency gains in circularity efforts were seen in the products themselves and the construction of production facilities of the sourdough company. A plan was developed in partnership with a construction company and a University of Applied Sciences to renovate the production facility using circular materials.

Process upgrading was also seen in the form of using PV panels in the sourdough company.

Functional Upgrading

Functional upgrading in an environmental sense was seen in research conducted by the marketing company on the amount of (recycled) cardboard in the packaging and the development of communication and marketing material for the bakeries to better market themselves to clients like food service companies.

Intersectional upgrading

Intersectional upgrading in environmental sense was not seen in this supply chain.

Conclusion

The level of environmental upgrading was considered to be high as new products were developed, aimed at mitigating food waste and active efforts were made to redirect the supply chain from using return bread as animal feed to using return bread as food for people. Also, environmental efforts were seen in new functions of the supply chain in packaging and marketing.

Social Upgrading

Social upgrading could be seen in the bakery company where efforts were made to produce mostly circular products during the day instead of at night when most of the production happened. Decent work conditions were ensured by a Collective Labour Agreement. The wages were even higher than stated in the Collective Labour Agreement and employees negotiated labour conditions with the employer. This resulted in a four-day workweek instead of five because most of the work was done during the night. The introduction of a four-day workweek had a social impact beyond direct employees as many workers were young parents, and the employer believed time should be spent with their children.

Furthermore, the company made efforts to hire individuals who faced barriers in the job market. They also collaborated with a social workplace in the search for an external producer to create biscuits from returned bread. This ensured that socially responsible practices were incorporated into the production process.

The sourdough company recognized that they were prioritizing environmental sustainability over social sustainability. Although they collaborated with the food bank to donate 15% of returned bread, they did not make any other social efforts.

During the interviews, it was mentioned that the interviewees believed, the majority of their social impact is achieved by leading the industry towards sustainability. The end goal is to have multiple small circular supply chains established throughout the country, where returned bread can be recycled to create new bread.

Conclusion

The level of social upgrading was high. This was substantiated by the considerable impact that workers had on the establishment of work conditions and the social impact this had outside of the direct supply chain.

Oyster mushroom grower (small)

Economic upgrading

Economic upgrading was not seen as the main goal of the collaboration, therefore this type of upgrading was only pursued to maintain business operations where circularity efforts were the main goal. The circular oyster mushrooms, and the products derived from them, were more expensive than the regular variants bought from a wholesaler but the restaurants were willing to buy them because of the circular ideology.

Product Upgrading

Product upgrading was seen in the form of product development for higher-margin products. In collaboration with external partners, products such as croquettes and bitter balls were developed. Further development was done on vegan 'zwamcijzenbroodjes' (oyster mushroom-based meat rolls), vegetarian 'worstenbroodjes' (traditional sausage roll) and oyster mushroom-based beer. Moreover, semi-manufactured products like oyster mushroom powder and dried oyster mushrooms were developed, aimed at the B2B market. The personal contact between the farmer and restaurant chef resulted in knowledge exchange in which the chef of the restaurant helped improve the specifications of the croquettes and bitter balls. Coffee waste was also upgraded in collaboration with a cosmetics producer into scrubs. The farmer also sold B2C grow-kits and oyster mushroom beer produced by other farmers operating the same business model.

Process upgrading

Process upgrading was not seen however in the future the farmer would want to pay the suppliers of coffee waste, as it is a raw material she argued. In the restaurant, efficiency gains were seen in the formation of one menu for all guests instead of the choice of several choices per course. In that one menu, circular products, including the oysters grown on their own waste were included.

Functional upgrading

Process upgrading was seen in logistics. The delivery of spores used to start the growing process was outsourced instead of self-collection and students were used to develop educational programs.

Intersectional upgrading

Intersectional upgrading was part of the core of this collaboration, especially for the oyster mushroom farmer. The farmer organised several activities like tours, workshops, company outings, lunches and cooking workshops. The farmer collaborated with educational institutions to provide lessons and practical assignments and was hired as an assessor for exams in business economics.

Conclusion

The aim of the collaboration was not to grow big but for the farmer to make a living wage out of it. Moreover, the higher margin products like bitter balls and croquets were no longer produced as the production partner stopped. Moreover, the COVID-19 pandemic was a major setback for the farmer. Therefore, the economic upgrading of this collaboration was identified as low.

Environmental upgrading

Product Upgrading

Product upgrading efforts were not seen specifically aimed at developing more environmentally friendly products. However, the restaurant was willing to pay more for the circular oyster mushrooms than the conventional variant because of the sustainability aspect and the personal relationship between the restaurant chef and farmer.

Process upgrading

On the farm, steps were taken to create an energy-neutral growing process. Electrical heaters were replaced with heat pumps and PV panels were installed to power them. To make the growing process more circular, research was also conducted by students to in the future use chalk from the municipal wastewater treatment plant in the growing process.

The farmer worked exclusively with local partners to collect coffee waste and deliver oyster mushrooms, reducing food kilometres. Even in collaboration with a major catering company, coffee company and the municipality, the farmer diverted the stringent order system and organised her local loop of coffee collection and snack delivery.

Functional upgrading

Functional upgrading was seen in increased marketing and communication efforts by the serving staff in the restaurant. During an evaluation, it was found that the communication of sustainable efforts and circularity practices towards restaurant guests was insufficient. To address this issue, a meeting about circularity was organised, led by an inspirational speaker, in which managers from different restaurants engaged in a discussion to exchange ideas on how to effectively communicate sustainability efforts, including the use of circular oyster mushrooms, to the guests.

Intersectional upgrading

No intersectional upgrading was found to increase sustainability efforts.

EnvU scoring

The oyster mushroom snacks are a more sustainable option compared to conventional snacks. Also, semi-manufactured products can be used to make other products more sustainable. However, no additional product development was carried out to reduce the negative environmental impact in collaboration with the restaurant specifically. Therefore, the overall level of environmental improvement is considered to be low.

Social Upgrading

Social upgrading efforts were seen in the employment of people at a distance from the labour market. The restaurant collaborated with an organisation that employed and guided people with mental difficulties. The safeguarding of working conditions was guaranteed by this external organisation. Working conditions of their own employees were established through collective labour agreements and personal consultation with employees themselves. The farm also employs a person with a distance from the labour market voluntarily rather than paid employment.

Additionally, the farmer provided learning opportunities to members of the 'Quiet 500' initiative. During workshops, one seat was always reserved for a community member of the Quiet 500 initiative.

Scoring social upgrading

Both parties in the collaboration made efforts to include individuals who are distant from the labour market. However, these social efforts were conducted externally from the collaboration. The worker's rights were guaranteed through a collective labour agreement and employees were able to discuss further work conditions with the employer, therefore social upgrading was seen as high in this collaboration.

Oyster mushrooms from brewpub**Economic Upgrading**

Economic upgrading was not seen in the collaboration. Economic downgrading occurred when the oyster mushroom grower raised service costs, meaning that the price for the customer would have risen. This collided with the social nature of the pub which tried to keep the prices accessible for everyone, causing the brewpub to stop buying mushrooms.

Product Upgrading

Product upgrading was not seen in this collaboration.

Process upgrading

Efficiencies were created by the oyster mushroom grower acting as a distributor for other local, circular products like lemonade.

Functional upgrading

The circular lemonade produced promoted the brewpub as one of their points of sale. This resulted in a better relationship between the pub and the producer of the lemonade.

Intersectional upgrading

The pub was furnished with reused furniture. In the brewery, the brewing process of the beer was vegan and plastic-free.

Conclusion

Economic upgrading of this collaboration was low, as due to rising costs.

Environmental Upgrading

No environmental upgrading was seen in this collaboration. Therefore this is considered to be low.

Social Upgrading

The oyster mushroom farmer does workshops about sustainability. Regarding labour conditions, the pub scored high. Personnel had an active say in the sustainability practices and proposed sustainable initiatives like a clothing swap. Moreover, when one person wanted a pay raise, this was discussed with all personnel within that layer, meaning it was raised either for everyone or that person would have more responsibilities.

Appendix III Overview scoring

CASE	DESCRIPTION	COMPLEXITY	AB TO CODIFY	CAP IN SUPPLY-BASE	PRODU	PROCU	FUNCU	INTERSECU	ENVU	SOCU	UPGRADING MECHANISMS
OYSTER MUSHROOM (SMALL) RELATIONAL	<p>Small-scale mushroom farm run by 1 person and two volunteers, producing 20kg of oyster mushrooms per week. Collaboration with restaurant based on personal contact.</p>	<p>High: Numerousness was low, as the flow of coffee and oyster mushrooms was small. The diversity of returned coffee waste was homogeneic in nature. Interdependency was high, as the oyster mushroom grower needed the restaurant to provide coffee. The variability of returned coffee was high as often it was contaminated. The variety was high, as the different parties were very different in nature. Uncertainty was</p>	<p>Low: No contracts were used. Only a self-fabricated stamp card was used to sustain transactions. No food-safety or other product standards were used.</p>	<p>High: The mushroom grower can grow 20 kilos of oyster mushrooms per week.</p>	<p>Low: Only Development of croquettes based on oyster mushrooms. Knowledge of chef helped in development process But snackproducer quit.</p>	<p>Low: No efficiency gains were seen in the collaboration.</p>	<p>Low: Marketing is very hard, as the farmer is by herself working with two volunteers.</p>	<p>Low: No intersectional upgrading was seen in the collaboration.</p>	<p>High: The oyster mushroom based snacks used 1000x less water than meat-based snacks. Less pollutants because growing facility is now run on heatpumps and PV-panels.</p>	<p>Low: People with a distance to the labour market were employed through a collective labour agreement. All people employed in the restaurant have the ability to influence working conditions.</p>	<p>Economic upgrading was no priority. Only product upgrading was seen based in collaboration between the two parties. Knowledge exchange from the chef to the grower was seen in the development of croquette recipes. Moreover, contacts were used to search for a new snack producer.</p>

high as often the
harves failed.

GAZPACHO PRODUCER	Gazpacho producer importing 'B-quality' fruits and vegetables and making gazpacho out of them. All three players are tightly integrated and shareholders of one company. Collaboration started in June 2021.	Low: Numerousness was low, as very little products were produced.	High: Numerousness was low, as the flow of coffee and oyster mushrooms was small.	Low: There were no sales so transactions could not be sustained.	Low: No more products were developed and introduced to the market next to the gazpacho.	Low: No more efficiency gains were developed. The value chain was already designed efficiently, based on the already existing value chain of the A-quality products and knowledge of the shareholders that worked in this industry for a long time.	Low: Marketing is very hard, as there is no budget.	Low: A process of product development was started to make beer out of bread.	Low: No efforts were made to make the collaboration more sustainable.	Low: No efforts were made to make the collaboration more socially sustainable.	No upgrading was found
EASY EXCHANGE		Diversity was high, as different ingredients were used.	The diversity of returned coffee waste was homogeneic in nature.								
		Interdependency was low, as both the conglomerate as parties in The Netherlands were not dependent on eachother.	Interdependency was high, as the oyster mushroom grower needed the restaurant to provide coffee.								
		Variability was high, as expected sales were not happening.	The variability of returned coffee was high as often it was contaminated.								
		Variety was low, as all players were already active in the same industry.	The variety was high, as the different parties were very different in nature.								
		Uncertainty was low, as there was no lack of knowledge.	Uncertainty was high as often the harvest failed.								

CIRCULAR COOKIES

LOCAL SOCIAL

<p>Company extracting ingredients out of organic waste and a cookie company, baking cookies with circular ingredients. Started in early 2020. The processing factory can process 30.000 kilotons per year.</p>	<p>Low: The numerousness is unknown in this collaboration. Diversity is low, as only one ingredient is used in this collaboration. Interdependency is low, as both companies can run without each other. Variability is low, as there is no variability between the expected and actual state of the value chain. The variety is high as the processing factory is vastly different from the cookie company. Uncertainty is high, as an application specialist is needed to transfer knowledge about the application of ingredients.</p>	<p>Low: No contracts were used to sustain the transaction. No formalised order systems were used. Food safety is very important so a data sheet with food safety documents is required.</p>	<p>High: The processing company created ingredients with the same product properties as the conventional variant, meaning the product requirements were fulfilled for the cookie company. For new ingredients, an application specialist was used to codevelop and help with the application of the new ingredients.</p>	<p>High: Codevelopment between the processing factory and the cookie company to use a new kind of fibre extracted from the organic waste in the cookies. Sometimes product development commissioned by a client.</p>	<p>High: Cookie company started combining orders to increase efficiency in the bakery and reviewed their machinery to reduce oven breakage of cookies. Increased efficiency of logistics by combining orders.</p>	<p>High: R&D efforts are integrated into the collaboration by experimenting with a new fibre from the organic waste. Marketing is conducted by the cookie company. Logistics are integrated and effectively used to increase efficiencies.</p>	<p>Low: No intersectional upgrading was seen in the collaboration.</p>	<p>High: Developing new ingredients to extract more ingredients from organic waste. Reduced food waste by reviewing machinery in the bakery to prevent cookie breakage. Also in collaboration with other partners.</p>	<p>High: Working conditions in the bakery were ensured through a collective labour agreement for bakers and audited. An improvement of gender equality was seen as women were employed to make them financially independent. Economic security of workers was improved so the women could be financially independent from their husbands.</p>	<p>Product development of ingredients in two phases: ingredient development in collaboration with knowledge institutes, application development in collaboration with bakery.</p>
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<p>BREWERY AND BAKERY</p> <p>LOCAL SOCIAL</p>	<p>Collaboration between beer brewer and bakery. The beer brewer provided spent grain as an input for bread. The beer brewer and baker had a personal connection for 20 years. The collaboration to produce bread from spent grain started in 2017.</p>	<p>Low: Numerousness was low, as the flow of spent grain was significant but not massive.</p> <p>Diversity was low, as there was only one flow of spent grain used for the bread.</p> <p>Interdependency was low, as both companies were able to thrive without each other.</p> <p>Variability was low, as the flows of spent grain and bread were as expected.</p> <p>Variety was low, as both companies worked with almost the same ingredients and knowledge was similar.</p> <p>Uncertainty was low, as knowledge was similar between teh two companies.</p>	<p>Low: No contracts were used to sustain transactions.. Trust is built on personal relationship.</p> <p>Officially an order file was used via Excel but it was hardly used in practise.</p> <p>Food safety standards were used.</p>	<p>High: High-quality (functional) foods were produced based on similar knowledge by the different parties in the collaboration.</p>	<p>High: Spent grain was used to develop several products like nonnevotten.</p>	<p>Low: Investments were made in a new proofer machine in the bakery, but no efficiency gains were seen in the collaboration.</p>	<p>High: The bakery has its own logistics. Marketing efforts were made but were unsuccessful.</p> <p>The bakery operated its own knowledge institute based on grain products.</p>	<p>Low: No intersecti onal upgrading was seen in the collaborat ion.</p>	<p>Low: The bakery started using green energy.</p>	<p>Low: Bakers were employed through the hospitality labour agreement but recieved above the wage for bakers, which was already higher.</p> <p>The bakers had a say in which machinery weer purchased but major influence in working conditions were lacking.</p> <p>Economic security was improved for employees with a distance to the labour market and Ukranian refueged, as</p>	<p>The owners of the two companies have known each other for 20 years and have similar knowledge as beer and bread. This allowed for product development in which a collaboration was started with knowledge institutes.</p>
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the bakery
educated
them and
offered a
job.

<p>CATERING COMPANY & OYSTER MUSHROOM GROWER MARKET</p>	<p>Catering company runs 350 locations in which every location has its specific collaborations with local partners. One of the locations has a collaboration with a big oyster mushroom farmer collecting coffee waste and growing oyster mushrooms on the substrate.</p> <p>The grower can grow 1200 to 1400kg of oyster mushrooms per month.</p>	<p>Low: The numerousness is unknown. Diversity is low as the flows only comprise snacks and coffee waste. Interdependency is low, as both parties can run without each other. Variability is low as there is no discrepancy between expected and actual state of the value chain. The variety is high, as both companies are very different. The uncertainty is low, as there are no difficulties as a result of lack of knowledge.</p>	<p>High: No contracts were used with the oyster mushroom grower. An order website was used to order oyster mushroom snacks. CO2 impact numbers were requested by the catering company. Moreover, the catering company required food safety documents from the suppliers and conducts audits.</p>	<p>High: The catering company required a CO2-impact calculation of the snacks and the mushroom grower provided impact reports.</p>	<p>Low: No product upgrading was seen in the collaboration.</p>	<p>Low: No process upgrading was seen in this collaboration.</p>	<p>Low: No functional upgrading was seen in the collaboration.</p>	<p>Low: No intersectional upgrading was seen in the collaboration.</p>	<p>Low: No environmental upgrading was seen in the collaboration.</p>	<p>Low: No social upgrading was seen in the collaboration.</p>	<p>This was a purely transactional relationship so no further upgrading was seen.</p>
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CASHEW COMPANY MODULAR	<p>In collaboration with cashew farmers and a peeling company in Tanzania, cashews and by-products are imported from Tanzania where the nuts are peeled. Broken cashews and cashew dust are also bought for a liveable wage, which would normally be wasted or sold for a discount.</p> <p>The collaboration started early 2022 and 1 million bags are sold within one year in supermarkets in The Netherlands.</p>	<p>High</p> <p>Numerousness is high as 125,000 kilo of cashew mix has been sold within one year.</p> <p>Diversity is low, as there is only one flow of cashews. Despite being 29 grades, all qualities are used so it was considered as one flow.</p> <p>The interdependency is high, as the Tanzanian companies depended on the Dutch cashew company for a livable wage.</p> <p>Variability was low, as the expected value chain did not differ from the actual value chain.</p> <p>Variety was high, as farmers, peelers, and the dutch cashew company are vastly different.</p> <p>Uncertainty was high, as a lot of</p>	<p>High:</p> <p>Renewal of new contracts every season.</p> <p>No formalised order systems were used as there were no computers in Tanzanian factory.</p> <p>A cashew grading system was used to categorise cashew products.</p>	<p>High:</p> <p>The cashew company were able to produce cashew products that satisfied customer demands.</p>	<p>Low:</p> <p>The cashew company also packed broken cashews, which would otherwise be used for lower value products like food ingredients. However, no new products were introduced next to the core product.</p>	<p>High:</p> <p>The mechanisation of the peeling factory in Tanzania brought efficiency improvement.</p>	<p>High:</p> <p>R&D was conducted to use cashew dust, the lowest grade cashew product, in cheese or ice cream.</p> <p>The cashew company conducted marketing activities.</p>	<p>Low:</p> <p>No intersectional upgrading was seen in the collaboration.</p>	<p>High:</p> <p>A project was started to also valorise the cashew fruit which now is left to rot and releases a lot of NO2. This will be further developed in collaboration with a local NGO. Also leads to less waste.</p>	<p>High:</p> <p>Wages of workers in Tanzania improved as a livable wage was paid by the cashew company.</p> <p>Labour rights were governed through a union in the factory and an overarching, national union.</p> <p>Gender equality was improved, as mostly women were employed and received a livable wage.</p> <p>The economic security of women was improved,</p>	<p>All cashew products are bought, even the broken nuts and grit from the peeling process. Strong focus on social upgrading.</p>
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knowledge was shared in the collaboration about e.g. new cashew breeds or market dynamics.

as they received help to open their own bank account and be financially independent from their man.

CIRCULAR BAKERY

MODULAR

<p>A bakery, fermentation plant and marketing company collaborate to ferment return bread into sourdough to use new bread.</p>	<p>High: The recycler processed 5000kg of returned bread per day. High diversity was seen in the composition of returned bread.</p>	<p>High: Contracts were used in the collaboration. A list was used to predict market demands and sustain future transactions. Food safety standards were used.</p>	<p>High: The collaboration was highly capable of producing circular bread due to the development of an in-house recycling machine.</p>	<p>High: Development of pita rolls, granola, kvass in collaboration with knowledge institutes. Italian rolls based on customer demands. Development of new shape of loaf to mitigate cutting waste, based on customer demands.</p>	<p>High: Charging higher prices so more money stays in the VC. New allergy vision system to make allergen sorting more efficient. In the process of getting the chain True-Price benchmarked.</p>	<p>High: Integration of marketing firm in the collaboration to do marketing, sales, and acquisition. In the process of integrating a green logistics company. R&D activities into new products.</p>	<p>Low: No intersectional upgrading was seen in the collaboration.</p>	<p>High: Product development based on customer demands: New shape of a special loaf to mitigate cutting waste. In the process of eliminating using bread as chicken feed which retains more value. The circular bread uses less grain and water than regular bread.</p>	<p>High: Circular products will mostly be produced during the day instead of night. Workers had a say in renegotiating worker hours so more time could be spent with their young children at home. Wages paid were higher than stated in the collective labour agreement for bakers.</p>	<p>Integration of the marketing firm allowed for growth by focusing on B2B customers. Product upgrading was done both in collaboration with knowledge institutes and based on customer demands.</p>
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<p>MICROBREWERY/PUB</p>	<p>Collaboration between a circular oyster mushroom farm/distribution circular food products failed because of a lack of communication and unnecessary costs for the collection of coffee waste.</p>	<p>High: Numerousness is low, as the flow of coffee waste is small.</p>	<p>High: A subscription contract was used to sustain the transaction of collecting coffee waste.</p>	<p>Low: The oyster mushroom grower was not able to adequately use the coffee waste to grow oyster mushrooms. The moulded coffee waste was unusable and the oyster mushrooms the brewpub received in return were of bad quality.</p>	<p>Low: No product upgrading was seen in the collaboration.</p>	<p>Low: The oyster mushroom grower raised their service costs.</p>	<p>Low: No functional upgrading was seen in the collaboration.</p>	<p>Low: No intersectional upgrading was seen in the collaboration.</p>	<p>Low: No environmental upgrading was seen in the collaboration.</p>	<p>Low: No social upgrading was seen in the collaboration.</p>	<p>No upgrading mechanisms were seen and the collaboration failed due to a lack of communication.</p>
<p>CAPTIVE</p>	<p>Interdependency is low as both companies can run without each other. Variability is high as the expected quality of oyster mushrooms is low. Variety is high, as both companies are vastly different from each other. Uncertainty is high as the collaboration failed as a result of lacking knowledge transfer.</p>	<p>Interdependency is low as both companies can run without each other.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>	<p>No product standards were used.</p>

