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The role of collaboration in reducing quality variability in Brazilian breweries

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ABSTRACT

This paper aims to analyse how small-scale breweries undertake vertical and horizontal collaborations to manage their quality performance (when measured by reducing quality variabilities). While vertical collaborations are overemphasised, horizontal and simultaneous collaboration efforts have been understudied. Our contribution lies in proposing an interplay of vertical and horizontal collaborations through information sharing, joint decision-making, and knowledge exchange with intra- and inter-supply chain partners to address quality variability issues. We draw attention to supply chain relationships being predominantly informal, which contribute strongly towards accessing external sources of knowledge. Additionally, such collaborative efforts have led companies to achieve mutual gains in their relationships. Finally, a framework is presented that consolidates the supply chain actors, collaboration types, socialisation mechanisms, and relationship types.

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Horizontal collaboration; quality variability; small-scale brewery; qualitative methodology

1. Introduction

Quality management has been an extensively studied topic in the Operations and Supply Chain Management (O&SCM) literature. Quality variability has been addressed in the past literature through management systems, like standardisation systems (Transchel, Bansal, and Deb 2016) and lean six sigma (Wang, Chen, and Tan 2019). However, how small and medium enterprises (SMEs) handles quality variability issues remain under-discussed. Most small and medium breweries (SMBs) face challenges for managing quality variations in their manufacturing processes and sustaining the same product characteristics over time (Parker et al. 2019). A set of microbiological elements, like variations in manufacturing time, pressure and temperature, exposure to oxygen after fermentation, and raw material composition, may affect their product flavour (Pellettieri 2015; Poveda 2019). Contrastingly, this is not a big concern for large companies as their standardised processes have sophisticated technologies for controlling the flavour variations in the laboratory and manufacturing departments (Ashwath et al. 2018).

Supply Chain Collaboration (SCC) can benefit higher quality at low costs (Fu et al. 2020), enhance responsiveness and recovery disruptions (Scholten and Schilder 2015), amplify visibility between supply chain members (Wieland and Wallenburg 2013), and mitigate bullwhip effects (Cao and Zhang 2011). Particularly, in the agri-food supply chain (AFSC), such collaborations can improve waste management and efficiency (Aggarwal and Srivastava 2016), reduce

logistics costs (Darestani et al. 2012), and help to build resilient supply chains (Leat and Revoredo-Giha 2013). SCC literature has been explored through three different perspectives – vertical, horizontal, and simultaneous (vertical and horizontal) efforts. However, there is a gap on how vertical and horizontal collaborations support SMEs in managing their quality performance, as most emphasis has been placed on vertical collaborations rather than horizontal or simultaneous collaborations (Zaridis, Vlachos, and Bourlakis 2020; Danloup et al. 2015).

This paper aims to address this gap by analysing how SMBs perform vertical and horizontal collaborations simultaneously to manage quality variances in products and processes while considering the characteristic of SMBs' scarce resources. Hence the research question arises here of how do SMBs perform horizontal and vertical collaborations to reduce quality variability issues?

A case study is carried out in the brewery industry with three SMEs. Eighteen semi-structured interviews are conducted with these companies and their partners. Respondents are selected covering a range of roles, including owners, production managers, brewer masters, laboratory workers, and sales managers. We have interviewed professionals from partner companies as well, such as buyers, suppliers, and competitors to increase research validity. Within-case and cross-case analysis techniques are used to support our findings.

The remainder of this paper is structured as follows: the next section on theoretical background covers the links

between quality and collaboration for the AFSC sector. In the research design [Section 3](#), the data collection method is presented along with the analysis method applied. The findings are presented in [Section 4](#) through within-case and cross-case analysis, followed by [Section 5](#) on the discussion of data considering the existing literature. [Section 6](#) concludes with final considerations, managerial implications, theoretical contributions, limitations, and further research directions.

2. Theoretical background

2.1. Quality variability

Quality variability refers to unstable processes that lead to less predictable outputs (MacKay and Steiner 1997). When variations in products are not well appreciated for customers, managing variability in processes at different manufacturing phases is required to maintain them satisfied (ElMaraghy et al. 2009). Companies have adopted quality management practices to control process variations, such as standardising manufacturing (Transchel, Bansal, and Deb 2016) and services (Chen et al. 2017). They are also implementing lean six sigma (Wang, Chen, and Tan 2019) and assessing international manufacturing networks with the support of value stream mapping (Arndt et al. 2019).

Most SMBs face a challenge of managing quality variability in their manufacturing, storage, and logistics processes. A set of microbiological elements, like variations in manufacturing time, pressure and temperature, exposure to oxygen after fermentation, and raw material composition, may affect their product flavour (Pellettieri 2015; Spedding, n.d.). For instance, Defernez et al. (2007) show how longer or shorter fermentation times can considerably affect the quality of beer batches. According to the authors, these must be processed correctly to reach specifications with the support of tools and techniques (e.g. present gravity and diacetyl techniques) before moving to the next production stages. Besides, Forster and Gahr (2013) revealed that distinct methods of adding hops (e.g. dry-hopping versus without dry-hopping) result in a great variability of beers' aroma.

Controlling manufacturing phases is a critical effort for SMBs to reach similar product flavours over time (Parker et al. 2019). It also influences bacteria proliferation issues in the processing and storage phases (Suzuki 2011). Particularly, this might represent a risk for customers when ingested above determined levels, leading to several symptoms (Poveda 2019). Therefore, more than just reaching similar consistency, flavour and appearance of products over time, control for variability emerges as a concern about microbiological issues along with the manufacturing steps. Companies can control these issues through quality tests, such as physical, sensorial, chemical, and microbiological, in raw material and manufacturing phases (Pellettieri 2015). Cantwell (2013) suggests that small breweries can rely primarily on sensorial tests as a great practice for quality assurance when working with limited technological resources.

2.2. Collaboration in supply chain

Collaboration in supply chain management can be defined from different perspectives. These perspectives present nuances related to how organisations join their efforts, which parties are involved in these processes of SCC, how long these efforts are employed, and why different organisations decide to work together. SCC could be characterised as a partnership (Zaridis, Vlachos, and Bourlakis 2020), a relationship (Arora et al. 2020), a structured integration (Zhao et al. 2008; Fu et al. 2020) of process coordination and information sharing (Williams et al. 2013; Wong, Lai, and Bernroider 2015; Fu et al. 2020) or even informal socialisation and mechanisms (Cadden et al. 2021; Poberschnigg, Pimenta, and Hilletoft 2020).

SCC literature emphasises the benefits, responsibilities, and governance mechanisms involved to act independently in the relationship and partnership aspect. In the integration aspect, quite diverse features are identified (Tsanos, Zografos, and Harrison 2014) incorporating elements of operational collaboration, information exchange (Paulraj, Lado, and Chen 2008; Prajogo and Olhager 2012; Liu et al. 2015), or cross-functional orientation (Eng 2005). Informal socialisation mechanisms emerge spontaneously when organisations jointly process to complete a task (Cadden et al. 2021), to promote cultural unity and relationship alignment (Cousins and Menguc 2006), or to build resilience (Poberschnigg, Pimenta, and Hilletoft 2020).

SCC is reached when two or more members collaborate to develop a competitive advantage (Moradlou, Roscoe, and Ghadge 2020). A partnership is common to describe collaborations between suppliers and manufacturers (Goffin, Lemke, and Szwejcowski 2006; Huang, Han, and Macbeth 2020). In comparison, supply chain integration refers to the intensity a manufacturer coordinates intra and inter-organisation to gain strategic benefits with its supply chain partners, with the objective of value creation and appropriation to its customers (Zhao et al. 2008; Fu et al. 2020). Few studies (Petersen, Handfield, and Ragatz 2005; Kim and Narasimhan 2002; Kotzab et al. 2011) have incorporated a wider view of collaboration with customers and suppliers (Tsanos, Zografos, and Harrison 2014).

Collaborative relationships can be either short-term or long-term (Meng 2020). It can be a short-term bargaining relationship, discrete exchanges (Arora et al. 2020), or project-specific, focussing on a single project (Manley, Shaw, and Manley 2007; Meng 2020). In contrast, a long-term bargaining relationship can be strategically oriented and sustained by multiple projects over a period of time (Akintoye and Main 2007; Meng 2020).

Different benefits or performance outcomes are identified to justify why organisations decide to work together. Cao and Zhang (2011) reviewed the literature, proposed a validated scale, and indicated seven distinct factors associated with collaborative efforts in supply chains: information sharing, goal congruence, communication, incentive alignment, decision synchronisation, resource sharing, knowledge creation. Collaboration also mitigates bullwhip effects (Cao and Zhang 2011) and prevents supply chain disruptions through

more visibility (Wieland and Wallenburg 2013). Moreover, it accelerates response and recovery time when disruptions are inevitable (Scholten and Schilder 2015) and produces high quality of products at low costs with an intention of providing maximum value to its customers (Zhao et al. 2008; Fu et al. 2020). Table 1 summarises the perspectives of collaboration from the supply chain literature.

2.3. Collaboration in the agri-food supply chains

In this section, selected literature related to collaboration in the AFSC sector is presented. We have categorised them by the type of collaborations: vertical, horizontal, or both.

2.3.1. Vertical Collaboration in the agri-food supply chains

Collaboration is about companies operating together beyond normal business-to-business (B2B) relationships. With changes in the last decade bringing risks to collaboration (e.g. restricting laws and regulations regarding food production and the number of partners), it has turned the AFSC a relevant context for SCC studies (Rota, Reynolds, and Zanasi 2013; Matopoulos et al. 2007).

From empirical studies, Matopoulos et al. (2007) distinguished two pillars to comprehend the AFSC and designed a framework for SCC: (1) the design and government of supply chain activities, and (2) establishing and maintaining of the supply chain relationships. The first pillar is related to making decisions of selecting the appropriate partner (business fit), selecting activities on which collaboration will be established (width of collaboration), and identifying at what level companies will collaborate (depth of collaboration). The combination of these three elements enables us to understand the first pillar as the intensity of collaboration. These elements are dependent on a fourth item, which is selecting the appropriate technique and technology to facilitate such information sharing (collaboration channel). This dependence is because not all collaborators can meet the collaboration requirements in technology and techniques (Matopoulos et al. 2007).

The second pillar is concerned with the construction and maintenance of relationships between collaborators. The elements identified for better and stronger relationships include mutuality of benefit, risk and rewards sharing (Barratt and Oliveira 2001), but also trust (Pomponi, Fratocchi, and Rossi Tafuri 2015; Kumar 1996), power and dependence (Caniëls and Gelderman 2007; Nyaga et al. 2013; Ambrose, Marshall, and Lynch 2010). These elements are essential because interdependency between companies will determine the company with higher power over the other, and form the basis for trust (Kumar 1996; Hingley et al. 2011).

Matopoulos et al. (2007) stated that the Agri-food industry structure might be complex as the number of companies participating in the supply chain increases. Companies need to make rational decisions by searching for relationships where a collaborative strategy will provide the greatest pay-off (Whipple and Dawn 2007). It is important, especially,

when the information exchanges can become problematic hindering supply chain collaboration as companies often do not have compatible systems for information sharing.

Another empirical research conducted by Aggarwal and Srivastava (2016) captured the nuances of buyers and suppliers' collaborative practices and perceptions towards collaboration to lower wastage and improve efficiency in a rice processor. They found that supplier selection, joint planning, and information sharing were the main antecedents, while profits, waste reduction, and supply chain efficiency were major collaboration outcomes.

2.3.2. Horizontal collaboration in the agri-food supply chains

While the above studies focus on vertical collaboration, (Darestani et al. 2012) examine the effects of a successful horizontal collaboration on logistics activities among a group of SMEs who participated in a purchasing consortium. After a cross-sectional quantitative survey, results showed a reduction of 10% to 30% in outbound logistics cost compared to when the firms were undergoing procurement by themselves.

An exploratory qualitative study investigated the benefits and barriers to use fourth-party logistics (4PL). This study interviewed informants from three suppliers, three logistic service providers, and one grocery (Hingley et al. 2011). These findings showed that 4PL negatively affects the grocery retailer-supplier dynamics, although it sometimes provides key potential benefits. Also, the investment in a large logistic service provider to facilitate 4PL control was a deterrent.

A longitudinal study sought to explore horizontal innovation network development within an artisan baker network as part of the UK SME agri-food sector (McAdam et al. 2014). The research was conducted over a twenty-seven months period to analyse an artisan baker horizontal network development and evolution. Conclusion pointed that knowledge-based open innovation and social network constructs support the concept of horizontal collaborative networks.

2.3.3. Vertical and horizontal collaboration in the agri-food supply chains

Vertical and horizontal AFSC collaboration involves all activities such as production processes, sharing information/infrastructure, skills and knowledge. And include different stakeholders, like farmers, food manufacturers, distributors, retailers, consumers, government, NGOs, finance providers, research centres, universities, and others.

Gellynck and Bianka (2010) place innovation as a central point to investigate the context of collaboration networking (retailers/wholesalers, food manufacturers, and suppliers) when applied to the beer and food sector. Data is collected through focus groups and in-depth interviews in three European countries: Belgium, Hungary and Italy. Their study points out that successful SMEs use their networks to overcome a lack of knowledge and information and create common use possibilities. The main barriers found are the lack of

Table 1. Perspectives of collaboration from the supply chain literature.

Perspectives of Collaboration	Considerations from the supply chain literature	Authors
How are efforts joined?		
Partnerships	‘Supply chain collaboration is a partnership where the parties work together, share information, resources, and risks, and make joint decisions to accomplish more benefits than acting independently’ Partnership has been particularly popular in describing collaborations between suppliers and manufacturers, but this does not imply that they have the same legal basis as a formal partnership structure of the type previously popular in consulting firms.	(Zaridis, Vlachos, and Bourlakis 2020) (Goffin, Lemke, and Szejcowski 2006; Huang, Han, and Macbeth 2020)
Relationships	Collaboration is often broadly used to describe inter-organisation relationships of all kinds, where supply chain partners attempt to work with each other to attain certain benefits. ‘Supply chain collaboration through coordination, adaptation and relationship building affect partner responsibilities in the supply chain along with price setting and governance mechanisms in inter-firm exchanges’.	(Huang, Han, and Macbeth 2020; Soosay and Hyland 2015) (Arora et al. 2020)
Integration	Supply chain integration explicitly identifies two aspects of the chain: information sharing and process coordination. Greater degrees of integration are achieved by facilitating the collaboration of supply chain efforts among all parties, improved communication and more blurred distinctions between the supply chain efforts of the company and those of its consumers and suppliers.	(Prajogo and Olhager 2012; Fu et al. 2020) (Prajogo and Olhager 2012; Liu et al. 2015)
Informal socialisation or informal mechanisms	‘Informal socialization mechanisms are emergent and spontaneous processes that occur when organizations come together to do a task’. There is a close link between collaboration capability and the literature on cross-functional integration concerning formal and informal mechanisms.	(Cadden et al. 2021) (Scholten, Sharkey Scott, and Fynes 2019; Poberschnigg, Pimenta, and Hilletoth 2020)
Which parties are involved?		
Suppliers and manufacturers	Partnership has been particularly popular in describing collaborations between suppliers and manufacturers.	(Goffin, Lemke, and Szejcowski 2006; Huang, Han, and Macbeth 2020)
Suppliers, manufacturers, and customers	‘We decided to interpret "integration" in terms of the basic supply chain flows (materials and information) and the coordination of the operational decisions required to manage them, both between the focal firm and its suppliers and between the focal firm and its customers’.	(Tsanos, Zografos, and Harrison 2014)
Intra-organisational	Supply chain integration refers to the degree to which an organisation strategically collaborates with its supply chain partners and manages intra- and inter-organisation processes to achieve effective and efficient flows of products, services, information, money, and decisions to provide maximum value to its customers.	(Zhao et al. 2008; Fu et al. 2020)
Inter-organisational	Collaboration as ‘co-operative behavior’ or ‘joint decision-making’ between companies engaged in inter-organisational efforts.	(Arora et al. 2020)
How long these efforts are employed for?		
Short-term	A short-term collaborative relationship is project-specific, focussing on a single project.	(Manley, Shaw, and Manley 2007; Meng 2020)
Long-term	In contrast, a long-term collaborative relationship is strategically oriented, being sustained in multiple projects over a period.	(Akintoye and Main 2007; Meng 2020)
Why do different organisations decide to work together?		
Benefits of performance measures	Information sharing, goal congruence, communication, incentive alignment, decision synchronisation, resource sharing, knowledge creation. Collaboration also mitigates bullwhip effects. Prevents supply chain disruptions through more visibility. Accelerates response and recovery time when disruptions are inevitable. Produce high-quality products at low costs, intending to provide maximum value to its customers	(Cao and Zhang 2011) (Wieland and Wallenburg 2013) (Scholten and Schilder 2015) (Zhao et al. 2008; Fu et al. 2020)

Source: The authors (2021).

understanding of the benefits, trust, knowledge of appropriate methods and skills, and financial and physical resources.

A survey conducted with farmers, wholesalers, retailers, brokers, and processors with 209 responses found that the lack of farmers’ group associations resulted in poor horizontal coordination. The absence of contracts also led vertical collaborations between the banana value chain actors to be weak (Warsanga 2014). The wholesalers capture higher mean price differences. This study recommends strengthening and establishing vertical and horizontal coordination among

actors to have a strong value chain structure for efficiency improvements.

Leat and Revoredo-Giha (2013) examined Scotland’s pork supply chains and have identified the key risks and challenges involved in developing a resilient AFSC, using collaboration amongst stakeholders (horizontal collaboration). A case study approach is selected, and in-depth interviews are conducted with seven senior people involved in the chain and its management. This case illustrates the importance of horizontal collaboration (shared innovation views and

increased production, exchange of useful information to improve performance and provide the scale and reliability of supply to large companies) and vertical collaboration (reduce market risk, attend producer meetings, and information sharing).

2.4. Supply chain collaboration literature gaps

Despite a considerable amount of literature on supply chain collaboration, there is still room for in-depth empirical investigations replicating previous studies in newer contexts (e.g. developing countries, SMEs and AFSC). One reason is that SCC is a constantly changing phenomenon (Yu, Zhang, and Huo 2020). Special mentions can be found relating to performance and research design gaps within the literature. Table 2 summarises these gaps in topics and subjects.

When supply quality management performance and collaboration are combined, it is possible to find the first set of

categories that deserve attention. From the topics that have been understudied are integrating suppliers earlier in the manufacturing phases to impact quality performance (Mandal and Jha 2018; Salimian, Rashidirad, and Soltani 2021; Zhang et al. 2018; Gimenez, van der Vaart, and Pieter van Donk 2012; Duhaylongsod and De Giovanni 2019) and the intricacies of supply chain oriented culture and quality performance (Zhang, Linderman, and Schroeder 2012; Schulze-Ehlers et al. 2014; Salimian, Rashidirad, and Soltani 2021). Specifically, these involve efforts for supply chain coordination and information sharing to impact quality performance in the AFSC context (Williams et al. 2013; Wong, Lai, and Bernroider 2015; Fu et al. 2020).

According to Ramanathan et al. (2020), studies do not explain how selecting suppliers for better performance outcomes (not exclusively for quality) could benefit sustainability, financial goals, and stronger collaboration links. Still, more research is needed to understand how the

Table 2. Gaps from the supply chain collaboration and quality literature.

Main topic	Subject	Highlights	Gaps from supply chain literature	Authors	
Performance	Supplier Quality Management Performance	Culture and quality performance remain understudied	A literature review indicates that the intricacies of Supply Chain Oriented (SCO) culture and quality performance have remained comparatively understudied.	(Zhang, Linderman, and Schroeder 2012; Schulze-Ehlers et al. 2014; Salimian, Rashidirad, and Soltani 2021)	
		Supplier integration and quality performance	Relatively recently, supplier integration has received significant attention as the integration of suppliers early in the development and manufacturing phases could substantially impact a firm's internal quality performance.	(Mandal and Jha 2018; Zhang et al. 2018; Gimenez, van der Vaart, and Pieter van Donk 2012; Duhaylongsod and De Giovanni 2019; Salimian, Rashidirad, and Soltani 2021)	
	Quality Performance Agri-food Supply Chain	Effects on the quality performance of products in AFSC are not clear	Supply chain managers argue that process coordination and information sharing can result in practical supply chain efforts. Still, their effects on the quality performance of products in agricultural supply chains are not clear.	(Williams et al. 2013; Wong, Lai, and Bernroider 2015; Fu et al. 2020)	
	Supply Chain Integration Performance	The link between integration and performance is weak	It appears that the link between integration and performance is not fully established.	(Tsanos, Zografos, and Harrison 2014)	
	Performance measurement systems (PMS) and supply chain collaboration	Do not include perception of practitioners	Studies on implementing PMS in collaborative supply chains fail to include the practitioners' perceptions about the factors that make supply chain collaboration beneficial to the partners.	(Hudnurkar and Rathod 2017)	
Performance/ Research Design	Supplier selection for sustainability, financial, and collaboration outputs	Selection of collaboration partners	Studies did not explain how collaborating partner selection affected the sustainability performance, financial performance, and collaboration output.	(Ramanathan et al. 2020)	
		Empirical evidence and unit of analysis (small and medium enterprises – SMEs)	Empirical evidence and SME performance	There is scarce empirical evidence on the direct effect of scale constraints' impact on supply chain collaboration and, in turn, SME performance.	(Zaridis, Vlachos, and Bourlakis 2020)
Research design	Empirical evidence	Empirical evidence on the alignment of SME, SCC, and firm performance	There is limited empirical evidence on the alignment of SMEs' strategy with supply chain collaborations and how it affects firm performance.	(Luo, Shi, and Venkatesh 2018; Towers and Burnes 2008; Hudson, Smart, and Bourne 2001; Zaridis, Vlachos, and Bourlakis 2020)	
		Empirical evidence – changing phenomenon	Collaboration in practice is characterised by a changing rather than a static nature – the phenomenon needs to be understood by more empirical evidence.	(Huang, Han, and Macbeth 2020)	
	Unit of analysis	Focus on the dyadic level	Empirical research on client selection is not commonly available.	(Ramanathan et al. 2020)	
	Construct validity	Variety of definitions lack a clear delineation of the concept	Heterogeneous feature of collaboration, from close and long-term to transactional	Relationship focus has mainly stayed at dyadic levels.	(Huang, Han, and Macbeth 2020; Soosay and Hyland 2015)
			Focus on vertical overlooking the benefits of horizontal collaboration	Such a variety of definitions suggests a lack of clear delineation of the concept.	(Tsanos, Zografos, and Harrison 2014)
			Little distinction is made between transactional and strategic relationships.	(Johnston and Staughton 2009)	
			The focus on collaboration does not sufficiently recognise different forms from close and long term to more transactional.	(Huang, Han, and Macbeth 2020)	
			The focus on vertical collaboration overlooks the benefits of horizontal collaboration.	(Danloup et al. 2015; Zaridis, Vlachos, and Bourlakis 2020)	

Source: The authors (2021).

implementation of performance measurement systems (PMS) in collaborative supply chains is done with practitioners' presence (Hudnurkar and Rathod 2017) and to strengthen the knowledge between performance and supply chain integration.

Empirical evidence is demanded to understand another set of gaps. SMEs normally present more resource constraints and require collaboration with partners to implement their strategies. These are both necessary to explore the direct impact of scale constraints upon supply chain collaboration (Zaridis, Vlachos, and Bourlakis 2020) and how SCC affect SMEs performance (Luo, Shi, and Venkatesh 2018; Towers and Burnes 2008; Hudson, Smart, and Bourne 2001; Zaridis, Vlachos, and Bourlakis 2020). Additionally, empirical research on client selection is not commonly available (Ramanathan et al. 2020).

Finally, there are gaps associated with research design with regards to the unit of analysis and construct validity. Similar to other topics in the field of supply chain management (e.g. supply chain risk and resilience), the unit of analysis for SCC more often focuses mainly on dyadic levels (Soosay and Hyland 2015; Huang, Han, and Macbeth 2020). Concerning construct validity, Tsanos, Zografos, and Harrison (2014) states that various definitions facilitate ambiguity to delineate what SCC is. Researchers attempt to rectify this by proposing different perspectives for supply chain integration, partnerships, relationships, or informal mechanisms for collaboration (Huang, Han, and Macbeth 2020; Scholten and Schilder 2015). While the benefits and features of SCC have been documented in the literature, the focus on collaboration still needs to recognise different types from short, medium and long term to more transactional. Moreover, the focus on vertical collaboration frequently overlooks the horizontal collaboration benefits (Danloup et al. 2015; Zaridis, Vlachos, and Bourlakis 2020).

3. Research design

Most of the barriers to SCC are related to the industry's complexity and heterogeneous structure, in which there are a number of entities linked from 'farm to fork', such as farmers, input suppliers, co-operatives, pack-houses, transporters, exporters, importers, wholesalers, retailers, and finally consumers (Matopoulos et al. 2007). For this reason, a multiple case study design is selected to empirically investigate SCC in AFSC and the challenges for SMBs in developing capabilities to originate quality products without variations on flavour and other practices, which lead to better value creation (Eisenhardt 1989; Eisenhardt and Graebner 2007).

The choice of research design is based on the philosophy assumptions adopted by the researchers. Saunders, Lewis, and Thornhill (2016) suggest researchers consider their philosophical stance as a '*multi-dimensional set of continua rather than separate positions*'. With that view in mind, a pragmatic philosophy combining both deductive and inductive inquiry methods is adopted for this study. And the choice of case study research design is influenced by this pragmatism philosophy. The pragmatic philosophy is driven by the research

questions that guide the selection of multiple or mixed methods to advance the research. The case study design is well accepted when research interest relies on identifying 'how' and/or 'why' questions. Other research designs like survey or experiment are unable to gather data for such lines of enquiry. Case study research is also recommended for in-depth analysis in a specific context of real-life (complex, unique, exploratory), such as AFSC collaboration (Leat and Revoredo-Giha 2013; Scholten and Schilder 2015; Aggarwal and Srivastava 2016).

The unit of analysis in this study is the focal company (SMBs). However, external players are also embedded in analysis to understand the collaborative environment created by them. Three focal companies and their relationships within the network of suppliers and buyers (vertical collaboration), and intra- and inter-departments and professional network (horizontal collaboration) have been studied. These companies are located in the South region of Brazil and are recognised for establishing a unique Beer College in Latin America. This region has received a big wave of craft breweries creating a cluster to share knowledge and value appropriation to bottle up quality products and stimulate market services. According to this cluster's criteria, the three cases have been selected to be SMEs that were created and are still administered by founders (Brewer A – 6 years, Brewer B – 7 years and Brewer C – 18 years). In this regard, these cases present more similarities and complementarities than polarities to search for evidence that could be characterised as replication logic.

The selection choice behind the Brazilian craft brewery sector is because of two main factors: its economic factor such as fast growth rate of over 700% in the last ten years (MAPA 2018) and its operational factor linked to their complex biological process control for maintaining the same product quality over time. Social and environmental factors related to entrepreneurship benefits, job creation, more retail services opportunities, and high dependence on natural resources also justify this selection. The main data collection process is interviews with respondents from focal companies, suppliers, and buyers.

A protocol has been developed with the support of two experts in the brewery sector – one professor in Brewery Science and the other is dean of a Brewery School in Brazil. The protocol has been pre-tested in three companies (two small and one large), intending to understand how supply chain collaboration leads to better quality, less variation on flavour and more value creation. We chose two small and one large to explore potential contrasts in the protocol. Amendments were addressed in the protocol regarding technical and technological terms.

Interviews are used as the primary source of data collection (see protocol in Appendix A). After the protocol was validated, we got the best quality company names from the two brewery experts. We contacted these companies for their first interview. Following this, a snowball technique was adopted to find additional respondents. In total, we conducted 18 semi-structured interviews with owners, production managers, a sales manager, brewers, a laboratory

Table 3. Companies' data.

Product	Case A Regional craft beer	Case B Regional craft beer	Case C Regional craft beer
Sales (approx.)	USD 6.0 mi per year	USD 3.0 mi per year	USD 1.5 mi per year
Foundation year	2015	2014	2003, but acquired in 2011
Production volume (liters monthly)	150,000 L	70,000 L	50,000 L
Interviews	7	5	6
Respondents positions	Owner, Production manager, Brewer ^a , Regional sales manager (raw material supplier), Production manager (competitor), Director (technology provider)	Owner, Production manager ^a , Brewer, Laboratory worker	Production manager ^a , Sales manager ^a , Purchase manager (buyer) ^a

Source: The authors (2021).

Note: ^atwo interviews with the same respondent.

worker, a director (technological provider), a regional sales manager (raw material supplier), and purchasing manager (buyer). Table 3 provides some descriptive information on the companies investigated. All interviews were recorded and transcribed in the Portuguese language, and then useful quotations were translated to English. On average, each interview was up to 40 minutes in duration.

For data analysis, content analysis is used for coding the interview transcripts using CAQDAS (NVivo Software). We selected main topics from the collaboration literature to code our interviews: information sharing, joint decision-making, knowledge exchange, mutual gains, socialisation mechanisms and relationship types. Information sharing is defined as when individuals or companies exchange relevant data (Fu et al. 2020). Joint decision-making refers to individuals or companies performing decisions together (Cao and Zhang 2011). Knowledge exchange involves when individuals or companies exchange a bundle of structured information (Cao and Zhang 2011). Mutual gains refer to the benefits of each relationship (Cao et al. 2010). Socialisation mechanisms are relationship forms adopted (Poberschnigg, Pimenta, and Hilletoth 2020). Finally, relationship type indicates the strategic intention of relations (Meng 2020). Table 4 provides information about our coding structure order.

For developing the research methodology of this study, the research onion model offered by Saunders, Lewis, and Thornhill (2016) is used. We started with the outermost layer of research philosophy, a pragmatic paradigm is selected with a combination of induction and deduction approaches. A case study method is chosen to answer the research questions, with interviews and content analysis as the data collection and data analysis methods respectively. Considering the limitations of the case study method for its low power of generalisation and lack of rigour (Stuart et al. 2002), the following tries to minimise biases and flaws in the data collection process (Voss, Tsikriktsis, and Frohlich 2002; Yin 2008):

- Construct validity: multiple sources of pieces of evidence like interviews with key informants, an exploratory phase, and validation of interview protocol with experts are carried out to measure studied concepts correctly;
- Internal validity: the interpretive (data saturation and mental process capture) and theoretical validity

(theoretical consistency and alignment to the data) has been considered in this study;

- External validity: as it follows a formal protocol (see interview protocol in Appendix A) future studies can reapply it for other sectors and supply chain networks;
- reliability: a research protocol is provided for future studies (see the interview protocol in Appendix A) that addresses reliability issues.

4. Findings

This section begins by presenting a within-case analysis of three cases. Then these cases are compared with each other in the cross-case analysis section, followed by a discussion on the aggregate dimensions.

4.1. Case A

Based on high quality and productivity mindset, company of case A started its operations with one of Brazil's highest technological manufacturing plants when considering the production volume. The manufacturing plant was co-developed with efforts from the company and a technological provider. While the highest technology contributed to the company gaining productivity and quality issues, it led the provider to strengthen its brand in the market. *'From our perspective, we hired a specialised consultant that contributed to us to build the best technology, and they [brewery] came here to co-develop their manufacturing plant'* (Director of the technology provider).

As the company owner is a member of the Convention Bureau, he is stimulating an information sharing environment among companies to develop the region's brewery sector. For doing so, he keeps the doors of his company open to visitors as a benchmarking example. *'They are working to engage all breweries for a co-operative environment [...]. A company came here to see a piece of equipment (centrifuge), then they bought a similar one with higher performance than ours. So, it is something that should be made jointly'* (Brew-master).

After having all equipment functioning properly, the company has been working to find the desired product quality. It has improved based on sensory analysis and discussions among different brewers. They taste beer lots and make joint

Table 4. Code structure.

First-order	Second-order	Aggregated dimension
Brewers sharing information about a manufacturing lot	Intra-departmental	Information sharing
Brewers sharing information about the next manufacturing lots		
Production and marketing departments sharing information about customers' need and downstream quality issues	Inter-departmental	
Production and laboratory departments sharing information about sensorial analysis and chemical components		
Company and customers (gipsies and B2B) sharing information about the general quality of the manufacturing lots	Inter-organisational	
Company and suppliers sharing information about technical information of materials		
Brewers (and/or production manager) making decisions based on sensorial analysis of manufacturing lots	Internal team	Joint decision-making
Brewers making joint decisions with the laboratory worker about new manufacturing lots		
Making joint decisions with experts for the development of new products	Professional networks	
Making joint decisions with a technology provider about the manufacturing plant	Supply chain partners	
Making joint decisions with buyers (gipsies) about the technical characteristics of their beer		
Exchanging knowledge by discussing the development of potential ingredients and materials	Professional networks	Knowledge exchange
Sharing experiments in an informal network of brewery professionals		
Attending workshops in the supplier plant	Supply chain partners	
Exchanging knowledge with buyers (gipsies)		
Acquiring technological expertise and productivity by developing a manufacturing plant jointly		
Integrating workers and departments towards a common cause	Benefits for breweries	Mutual gains
Developing a critical sense of brewers		
Creating a reputation for their products and brand		
Acquiring expertise and knowledge (technology provider and professional network)	Benefits for partners	
Increasing sales and market share (raw material suppliers and customers)		
Developing the sector in the region (competitors and all breweries)		
Implementation of outstanding practices from the internal network	Quality practices implementation	Reducing quality variability
Implementation of outstanding practices from the external network		
Technology (production equipment, automation, and laboratory)	Standardisation	
Standardisation of internal and supply chain processes and asepsis		
Standardisation and long-range contract with key raw materials suppliers		
Pre-disposition for quality as a strategic focus	Strategic intention	
Quality as an organisational asset		
Established access and communication to partners (e-mails, letters, workshops and teaching)	Formal	Socialisation mechanisms
Informal access, conversation and exchange mechanisms with partners	Informal	
Project-based relationships and specific demands	Short-term	Relationship types
Long-range relationships	Long-term	

Source: The authors (2021).

decisions for potential amendments and corrections to the next manufacturing lot. Hence, collaboration among the four brewers led the company to create a standard product with reduced variability. '*[...] we also do a daily analysis of the product in the beer tank, for tasting the beer, so we discuss if it is bitter or whether something is missing [...] then it will influence the next manufacturing lot, and we will change something*' (Brewer). Also, some of the experts from brewers' professional network are demanded by social networks to share their viewpoints and expertise related to combinations of materials, best practices and quality methods.

The company has decided to assign a formal contract to one key raw material supplier to reduce oscillations from materials. '*[...] for example, we have a formal contract with one hop supplier, then they have ensured quality and delivery on time by contracts, which is important because some harvests can change when compared last year*' (Brewer). Particularly, this has contributed to the company reducing variability from the raw material that reflects on the final product quality.

Finally, the company produces beer for buyers (B2B) to fill their production capacity [called gipsies]. Regarding their

experience in producing beer, they often share information to improve buyers' assessment of product quality. Also, it includes few joint decision-making rounds where the company and their customers look for quality development. '*[...] as it is a partnership, we provide our point of view and them as well. For example, they have not too many judgments because they do not have a brewery; they have not brewers; they have not any background in brewing*' (Brewer).

4.2. Case B

Case B presents an innovative company that has received national and international awards for products that encompass different tropical characteristics. Hence, maintaining the appearance, flavour, and robustness of the product over time are priorities for them. Because of this, the company decided to move forward with sensory analysis among brewers and invest in a laboratory department to carry out physical, chemical and microbiological tests. The lab contributes to managing variations in raw materials and water, while controlling the manufacturing processes to make decisions supported by data rather than perceptions only. This point also

contributed to defining parameters and towards standardising the processes. *'[...] for example, sometimes we (brewers) can taste a beer and feel it a little bit sweet, so sweet, not good, so heavy. The laboratory report provides evidence about the beer features, so high, and we must reduce it because it should be in 3 or 3.5. Based on this, we go improving. You run the sensory analysis and the lab as well'* (Production manager).

The company has decided to buy raw materials from key suppliers to reduce potential variations in it. They have also shifted towards participating actively in workshops promoted by its main raw material supplier; discussing how to achieve the highest quality level when controlling malt barley, hop and enzyme. *'For understanding the raw material used in your process, you can use it better and improve your quality as a consequence. They do not sell just barley malt, but hop, enzymes, other things. So, we learnt a lot from their workshops [...]'* (Production manager).

Plus, the company has made some collaborative products with other companies (B2B). This collaboration led both companies to exchange knowledge on their manufacturing processes and quality issues. *'We (the company) have some gipsies in the plant then we exchange knowledge, information sharing is high too'* (Owner).

Finally, most of their staff members use a professional network built for quality development purposes. Regardless of each network member's company, they put their thoughts out to exchange knowledge as it facilitates conversations for mutual gains among the members. This company uses external experts' viewpoints to make decisions on developing new products and quality issues. *'It is a network of colleagues that I am building. I have a group email, WhatsApp, I call them as well, so I have Professors that taught me [...] they know too much; I am always close to these people [...]. I sit down with a sommelier (a brewery expert), a very experienced guy about foreign beers. He does not produce, but he listens to how I am working, then he recommends some important ways. I made some changes to his comments, and we have received one gold and other silver awards. It was his influence. I consider him. All beer that I am producing, he is the first guy that tastes'* (Production manager).

4.3. Case C

Case C is a SMB that was acquired after some successive negative financial results. The new board have come up with a different administrative approach and quality mindset. For doing so, they hired an experienced brew-master to guide brews for best quality practices. He comes to the company to run joint sensorial analysis and make decisions from them, while exchanging knowledge with the production manager. *'The company's differential is that we have a brewmaster graduated from Germany [...]. Actually, he is old, very old, then all his knowledge he is moving to me. Once per month, he is coming into the company to check beer lots, then we talk a lot [...]'* (Production manager).

On the other hand, the manufacturing department maintains a close relationship with the marketing department that

helps sharing relevant information from customers and consumers. It allows the company to reduce quality claims, address current product issues, and prepare more effectively for new developments. *'Sometimes I bring him with me (production manager) to visit customers, it is good because all customers to feel attended effectively [...] it provides credibility to the customers and creates a relationship with them [...]'* (Sales manager). *'We (company) have a CRM, so she (administrative assistant) is taking note about claims and suggestions [...] we had so many claims, product variability, product out of shelf life [...], and oxidation [...], asepsis [...], so we changed many processes [...] I suppose there are around 4 or 5 months without any claim. It was impactful.'* (Production manager).

The company also directly connects to its main supplier by sharing information about fresh products and their forecasted demands. This collaboration helps the company maintain the same quality of their products with the same supplier, and the supplier is also earning profits with a stable sale of their materials. *'[...] when they lack hop, they (raw material supplier) contact us, so we buy a larger quantity'* (Production manager).

Finally, a professional network supports the Production Manager to bring about quality improvements in the company. Regarding this practice of knowledge exchange among experts, he describes: *'brewery today is information exchange. It is what I am telling to all the world [...] Why? I might face an issue that I don't know, then I talk to you to solve it very fast, so I saved time and resources [...] I have experienced colleagues that have 40, 50 years of experience in the brewery sector [...] we exchange a lot of knowledge'* (Production manager).

4.4. Cross-case analysis

This section compares the dimensions that emerged from our interview data – information sharing, joint decision-making, exchange knowledge, reducing quality variability, mutual benefits, socialisation mechanisms and relationship types. Table 5 provides evidence for this cross-case analysis.

4.4.1. Information sharing

Information sharing appears to be a common practice adopted in all three cases. It has been manifested in three different levels – intradepartmental, interdepartmental and inter-organisational. Firstly, brewers are expected to perform daily sensory analysis about manufacturing lots, which allows them to share technical information related to flavour, aroma and robustness of beer (all cases). Secondly, case B indicates the production and laboratory department's sharing of information to match sensorial and laboratory analysis. And case C shows the marketing department's role as customers' voice in providing key information evidence from CRM to manufacturing and managing quality issues. Thirdly, suppliers often share the best quality practices about raw materials (all cases). And gipsies (service buyer – cases A and B) and customers (B2B) (case C) provide additional information about processes and products, respectively.

Table 5. Cross-case analysis.

Aggregated dimension	Second-order category	Case A	Case B	Case C
Information sharing	Intradepartmental (H)	Performing sensorial analysis among brewers	Performing sensorial analysis among brewers	Performing sensorial analysis among brewers
	Interdepartmental (H)	N/A	Matching sensorial (brewers) and technical analysis (lab) of the beer	Sharing information between manufacturing and marketing departments
	Interorganisational (V)	Sharing information with competitors, raw material suppliers and customers (gipsies)	Sharing information with raw material suppliers and customers (gipsies)	Sharing information with raw material suppliers and receiving feedback from customers (B2B)
Joint decision-making	Professional network (H)	N/A	Listening comments from experts and sommeliers about their products	Brewmaster contributing in making a joint decision about current and next manufacturing lots
	Internal teams (H)	Brewers making a joint decision about the next manufacturing lots	Brewers and laboratory worker making a joint decision about current and next manufacturing lots	Brewers making a joint decision about the next manufacturing lots
	Supply chain partners (V)	Making the decision about the cost/benefit of equipment and processes	N/A	N/A
Knowledge exchange	Professional network (H)	Exchanging knowledge with experts	Exchanging knowledge with experts	Exchanging knowledge with experts
	Supply chain partners (V)	Exchanging knowledge with the technological provider	Exchanging knowledge with customers (gipsies)	N/A
Reducing quality variability	Quality practices implementation	Waters minerals correction, daily sensorial analysis, specific laboratory analysis with external partners	Daily sensorial analysis, investment in a laboratory to run physical, chemical and microbiological tests	Waters minerals correction, daily sensorial analysis, specific laboratory analysis with external partners
	Standardisation	High automation level, and processes and material standardisation	Processes and raw material suppliers standardisation	Processes standardisation
	Strategic intention	Quality as a requirement of the owner and organisational mission	Quality as a competitive priority, maintaining the same beer overtime after awards	Quality as a requirement to maintain the company in the market
Mutual gains	Benefits for breweries	Reputation, the strength of the brand, integrating intra-dept and developing critical workers	Reputation, integrating intra- and inter-dept, and developing critical workers	Integrating intra- and inter-dept, and developing critical workers
	Benefits for partners	Acquiring expertise (technology provider), sales (raw material supplier), quality of products (gipsies) developing expertise (professional network), benchmarking and developing sector (competitors)	Sales (raw material supplier), quality of products (customers), developing expertise (professional network)	Sales (raw material supplier), quality of products (customers), developing expertise (professional network)
Socialisation mechanisms	Formal	Contracts (technology provider, raw material supplier)	Beer parameters (laboratory – inter-dept), workshops and contracts (raw material supplier)	CRM evidences (inter-dept), contract (raw material supplier)
	Informal	Benchmarking (competitors), brewers' discussion (intra-dept), brewers sharing best practices (professional network, gipsies)	Brewers' discussion (intra-dept), brewers sharing best practices (professional network)	Brewers' discussion (intra-dept), brewers sharing best practices (professional network), Marketing as a customer voice to Manufacturing (Inter-dept), Voice of customer (Buyer B2B)
Relationship types	Short-term	Technology provider and gipsies (project-based)	Gipsies (project-based)	Brewmaster (project-based – knowledge source)
	Long-term	Competitors (sector development), raw material supplier (supplying quality materials), intra-dept and professional network (knowledge source)	Inter-dept with lab, intra-dept, professional network and raw material supplier (knowledge source)	Inter-dept with marketing, intra-dept, professional network and buyers (B2B) (knowledge source), raw material supplier (supplying quality materials)

Source: The Authors (2021).

Notes: (H) Horizontal collaboration; (V) Vertical collaboration.

4.4.2. Joint decision making

Joint decision making is another collaborative practice adopted by small breweries. This pattern has been perceived from three distinct sources – internal teams, professional network, and supply chain partners. The internal team makes joint decisions related to current and next manufacturing lots (cases A and C), mainly after sensorial and laboratory analysis (case C). The professional network comes up as a complimentary resource for companies. They contribute to decisions related to products and manufacturing processes to maintaining repeatability (e.g. experts, brew-master, and sommelier – cases B and C). Finally, only case A included a technology provider's participation in making decisions jointly about their manufacturing plant. After several discussion rounds, it allowed them to achieve the highest product quality and productivity standards with the acquired technology.

4.4.3. Exchange knowledge

Exchange knowledge is the third collaborative pattern that has emerged out from our data. On one hand, breweries are using professional networks to access complementary knowledge (all cases). It has been mainly through brewers and production managers handling quality variability issues in the frontline. Hence, such professional networks contribute to SMBs accessing complementary knowledge and accelerate measures to reduce quality variability. On the other hand, our data suggest case A exchanging knowledge with the technology provider when handling its manufacturing plant project, whilst case B exploring new knowledge when providing service for customers (gipsies). Both have contributed to handling product quality issues.

4.4.4. Reducing quality variability

The quality variability is a major issue for SMBs managing variations with limited resources. The three cases have shown distinct ways to manage that with the support of multiple collaboration sources – implementing quality practices, standardising manufacturing steps, and having quality as a strategic intention. First, with the support of multiple sources, the three cases implemented several quality practices. It includes water mineral corrections (case A and C), daily sensorial analysis (all cases), external laboratory analysis when required (cases A and C), and investing in a laboratory to run physical, chemical and microbiological tests properly (case B). Second, several standards have been adopted along with the manufacturing steps by the breweries to reduce variations. For example, high automation in the manufacturing phases to reduce human interference (case A), standardisation in the manufacturing processes – performing tasks at the same way (all cases), asepsis (all cases), raw materials minimum standards required (case A), and reducing the number of suppliers (case B). Third, all three cases present strategic intentions related to product quality issues, so quality is seen as an organisational mission (case A), a competitive priority (case B and C), and a way to continue delivering the awarded beers (case B).

4.4.5. Mutual benefits

The collaborative efforts allowed breweries to adopt a set of measures that resulted in more stable manufacturing processes and reliable product characteristics. Consequently, breweries could increase the brand's reputation and strength, integrate intra- and inter-departments, and develop workers' critical sense. On the other hand, the partners also gain different benefits from these relationships, for example: (a) raw materials suppliers gaining sales, market share and loyalty of buyers (all cases), (b) customers (B2B and gipsies) gaining in the quality of products (all cases), (c) professional network sharing and absorbing information and knowledge (all cases), (d) technology provider developing and validating new products (case A), and (e) competitors benchmarking and contributing towards the economic development of the sector (case A).

4.4.6. Socialisation mechanisms

The cases have used formal and informal mechanisms of socialisation to carry out the collaborative efforts. Formally, contracts have been adopted to manage raw material suppliers (all cases) and workshops to share best practices with breweries (case B). In this regard, documents with product characteristics and parameters (case B) and evidence from CRM (case C) to production managers' concern of the current and next manufacturing lots. Informally, the brewers' discussions related to sensorial analysis (all cases) and sharing best practices with professional networks (all cases) are predominantly found in our data. Even benchmarking with competitors (case A), marketing as a customer voice catalyst while translating different customer needs to the production manager (case C) and as buyers' voices (B2B) (case C) have appeared as informal mechanisms of socialisation. Finally, only inter-department appeared as a formal and informal mechanism depending on the context.

4.4.7. Relationship types

As discussed in the literature review section, there are long-term and short-term (transitional) relationships types. Companies identify the best routes to create value with their supply chain relationships according to the strategic benefits and gains. Our data from SMBs suggest few short-term relations acquire specific assets from a project-based agreement, for example, gipsies (cases A and B), technology provider (case A) and brew-master as a skilled professional from the network of the CEO (case C). Otherwise, long-term relationships arise as the main focus of SMBs but in different directions. First, intra-department (all cases), inter-department (cases B and C), professional networks (all cases) and buyers (B2B) (case C) are identified as sources of knowledge. Second, long-term relationships with raw materials appear to supply high-quality materials (cases A and C), and it is also found as a source of knowledge (case B). Third, competitors are seen as a relational actor to developing the sector within the researched region (case A).

5. Discussion

This section brings findings and literature review together to discuss this study's research question: **how do SMBs perform horizontal and vertical collaborations to reduce quality variability issues?** This question raises a debate still underexplored by prior literature, which this study provides valuable reasonings from both empirical and theoretical sides.

Like any other food and beverage company, breweries should prioritise sanitary and quality issues to provide safe products for customers (Suzuki 2011; Poveda 2019). The sensibility of materials, processes and technology employed, variations along manufacturing processes and materials may result in different product characteristics (Pellettieri 2015). Hence, controlling manufacturing phases is a critical effort for small breweries to obtain consistent product flavours over time (Parker et al. 2019). However, as mentioned by prior literature, SMEs present bigger resources constraints requiring more and wider collaborations to fill the lacks (Zaridis, Vlachos, and Bourlakis 2020). Gellynck and Bianka (2010) argue that SME breweries use their networks successfully to overcome barriers related to knowledge and information. Past research overemphasises the vertical collaboration element over the horizontal collaboration benefits (Danloup et al. 2015; Zaridis, Vlachos, and Bourlakis 2020). Our study extends these debates by arguing that SMEs resource constraints (Zaridis, Vlachos, and Bourlakis 2020) can be overcome through vertical and horizontal collaborations with internal and external partners simultaneously. This evidence provides an empirical contribution to the literature regarding SMEs strategy alignment, SCC, and performance (Luo, Shi, and Venkatesh 2018; Towers and Burnes 2008; Hudson, Smart, and Bourne 2001; Zaridis, Vlachos, and Bourlakis 2020). Also, the simultaneous role of collaboration – vertical and horizontal, with internal and external partners, cast significant influence on breweries' quality performance.

Past literature has discussed the effects of collaboration on AFSC's quality performance (Williams et al. 2013; Wong, Lai, and Bernroider 2015; Fu et al. 2020). This study contributes to this debate by arguing multiple actors' efforts – internal and external – towards developing higher quality processes and controls. While the collaboration happened through the partnership of multiple actors (Goffin, Lemke, and Szwejczewski 2006; Huang, Han, and Macbeth 2020; Zaridis, Vlachos, and Bourlakis 2020), the integration level to partners took place via information sharing, joint decision-making and knowledge exchange (Prajogo and Olhager 2012; Liu et al. 2015; Fu et al. 2020). This research extends prior literature (Tsanos, Zografos, and Harrison 2014) for establishing a clear link between integration to quality performance. In other words, higher integration with key partners allowed SMBs to access complementary and strategic resources to improve their quality performance. Finally, researchers have paid attention to early supplier integration and its impact on quality performance (Salimian, Rashidirad, and Soltani 2021; Duhaylongsod and De Giovanni 2019; Mandal and Jha 2018). This study includes horizontal partnerships within this collaboration process – such as professional

network and cross-functional activities (e.g. intra- and inter-department collaboration).

In the literature, there is a scarcity of studies that connect supply chain orientation to quality performances (Zhang, Linderman, and Schroeder 2012; Schulze-Ehlers et al. 2014; Salimian, Rashidirad, and Soltani 2021). Our study contributes to this in two ways. First, all three cases presented how their supply chain orientation help reach complementary resources from external partners. Second, vertical and horizontal collaborations allowed all three companies to accelerate the learning of manufacturing practices, processes and control associated with concerns of quality variability. Thus, companies' strategic intention with the supply chain orientation is revealed as a potential source for external partners.

Prior research calls attention to collaboration as a dynamic phenomenon rather than a static nature (Huang, Han, and Macbeth 2020). In contrast, little attention has been devoted to distinguishing between transactional and strategic relations (Johnston and Staughton 2009) or sometimes comprehended as short versus long-term relationships (Huang, Han, and Macbeth 2020). Our study found certain short-term relations attending to a specific company demand (Meng 2020). Still, the majority are found to be long-term relationships contributing to a knowledge source, mainly, regarding scarce resources of SME (Zaridis, Vlachos, and Bourlakis 2020). These results extend the current literature twofold. Firstly, collaboration is seen as a dynamic phenomenon, as found by previous literature (Huang, Han, and Macbeth 2020), but it aligns with the companies' strategic intention. Hence, the company managers decide which type of collaboration will contribute towards reaching those company goals. Our study indicates that the dynamism of collaboration is driven by this requirement of meeting company goals. Secondly, building upon prior studies (Johnston and Staughton 2009; Huang, Han, and Macbeth 2020), our research suggests that short-term and long-term are important relationship forms to reach external resources depending on company's strategic goals. While short-term relationships are project-based efforts and useful to access specific resources (e.g. best manufacturing practices), long-term ones are those in what preference is given to absorb strategic resources (e.g. knowledge, information, learning, etc.) for continuous improvements.

Most supply chain studies have focussed on the dyadic level when analysing relationships (Soosay and Hyland 2015; Huang, Han, and Macbeth 2020). Although it is a valid way of accessing the supply chain dynamics, it appears limited compared to the number of existing relationships in each organisation. Based on the three case studies from the brewery sector, our study showed empirical evidence coming from eight actors working collaboratively, three collaboration types, two relationship types, and two socialisation mechanisms. These networks become potentially more complex when the perspective of interest for each party is included in these relationships. Hence, our research suggests that it is necessary to identify the parties involved in a cooperative environment and the benefits for each actor (Cao et al. 2010; Cao and Zhang 2011; Barratt and Oliveira 2001) to have a clear understanding of the SCC. Keeping in mind that

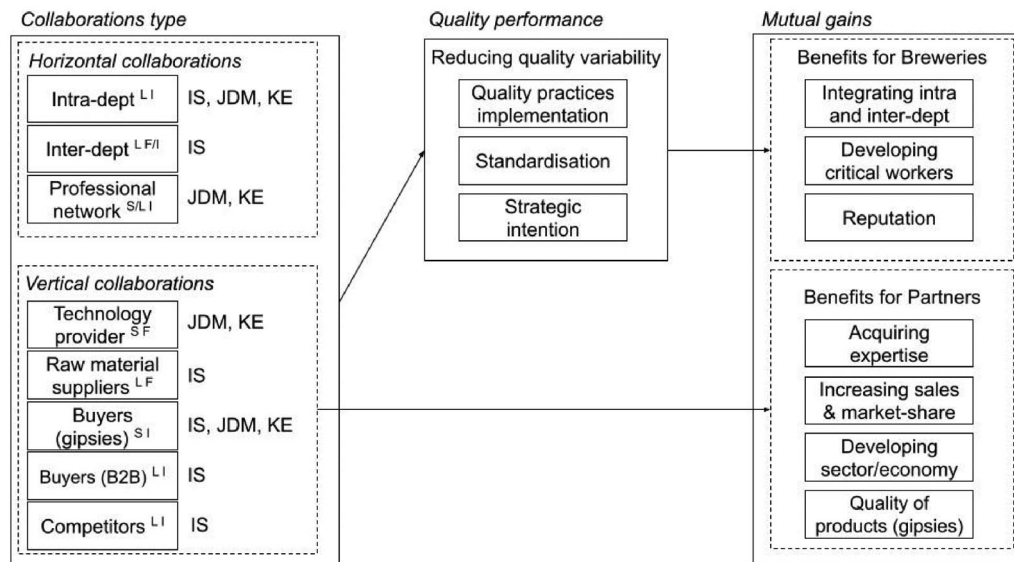


Figure 1. Framework for reducing quality variability in SME breweries. Notes: Collaboration types: IS: Information sharing; JDM: joint decision-making; KE: knowledge exchange. Socialisation mechanisms: ^FFormal, ^IInformal. Relationship types: ^SShort-time; ^LLong-term. Intra-dept: Intra-department; Inter-dept: Inter-department. Source: The authors (2021).

nobody intends to work on a win-lose collaboration, we argue that collaborative efforts in the supply chain are usually supported by mutual gains and involve several actors contributing simultaneously. Particularly, these aspects extend past literature (Ramanathan et al. 2020) on partners' selection.

Finally, two social mechanisms have been adopted by companies to manage their relationships – formal (e.g. contracts) and informal (e.g. brewers' discussion and sharing best practices) as seen from past literature (Cadden et al. 2021; Poberschnigg, Pimenta, and Hilletoft 2020; Scholten, Sharkey Scott, and Fynes 2019). Companies in this study have predominantly adopted an informal mechanism. Particularly, our research adds some value towards this debate for highlighting the informal mechanism as the quickest manner to create a rapport among supply chain actors and networks, and to start creating value from it. Figure 1 suggests a framework showing eight different collaborative relations to reducing quality variabilities and gaining partner benefits with collaborative efforts. The framework consolidates all actors, collaboration types, socialisation mechanisms, and relationship types contributing towards developing quality performance in small and medium breweries.

6. Conclusion

The collaboration topic has been extensively discussed in the supply chain literature; with limited research being carried out on SMEs and quality performance. Findings suggest that SMEs interplay simultaneous collaborative efforts (vertical and horizontal) with multiple actors (internal and external) through different types of relationships (short- and long-term) and social mechanisms (formal and informal). Such collaborations help to reduce quality variabilities in products and processes with limited resources. These collaborative efforts also lead to mutual benefits – while SMBs reduce

quality variability issues, partners can create value from this relationship being aligned to their own interests.

This study provides several theoretical contributions. First, this study responds to empirical evidence calls (e.g. Zaridis, Vlachos, and Bourlakis, 2020) by examining the supply chain collaboration of SMEs towards enhancing their quality performances. Second, this study extends the current O&SCM literature by arguing that SMEs can reduce variability issues through collaborative efforts rather than implementing formal quality systems (e.g. TQM, Lean Six sigma) as larger companies do (Wang, Chen, and Tan 2019). Collaborating with multiple partners allows SMEs to learn faster through interactions, save resources and improve quality with manufacturing best practice implementation, standardisation and enhanced strategic focus on quality. Third, current O&SCM literature overemphasises vertical collaboration efforts (Zaridis, Vlachos, and Bourlakis 2020; Danloup et al. 2015), while our study argues that having both vertical and horizontal collaborations simultaneously is the best route for SMEs to reaching a higher quality performance level. Finally, SMBs can benefit from collaborations towards a differentiation strategy while competing in their markets.

This study also provides some managerial implications in addition to the above theoretical contributions. Firstly, this study points out how companies could access complementary resources when collaborating vertically and horizontally. However, such collaborations are dependent on the strategic intention of the companies. In other words, managers must pay attention to the value created from each collaborative relationship and then identify strategic resources that can contribute towards meeting those intentions. Secondly, simultaneous collaboration with multiple actors is recommended to amplify access to external resources such as information and knowledge. Thirdly, resources can come from both short- and long-term relationships. Managers need to identify how external players can contribute to their strategic planning, then evaluate how they can explore those relational values. Lastly, rather

than implementing formal quality management programs which take enormous amounts of resources (money, time, professionals, etc.), SME managers can benefit from supply chain collaborations to access complementary resources contributing towards reduced quality variabilities.

Like any other research, this study too has some limitations for the work carried out. First, only three companies and their partners have been considered in the sample, while sectoral associations and institutions are not included in the analysis. These actors may have a strong influence on the companies' quality performance – especially SMBs, by providing best practices, reports, and consultancy. Second, we have analysed SMEs from an emergent country whose results may differ from developed countries due to peculiarities in culture, social ties, institutional and industry aspects. Third, the results are applied just for SMBs as large companies do not face higher technological investments. Future studies can address these limitations by handling samples from higher and inadequate technological infrastructure, by exploring similarities and differences with developed countries, and by including different actors (e.g. associations and institutions) in the potential sample. According to managerial profiles, regions and sectors, further research may also explore behavioural aspects of SCC, such as collaboration types, relationships, social mechanisms and actors. Future studies can also explore the role of professional networks in supply chain design and SMEs performance.

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References

- Aggarwal, Shikha, and Manoj Kumar Srivastava. 2016. "Towards a Grounded View of Collaboration in Indian Agri-Food Supply Chains." *British Food Journal* 118 (5): 1085–1106. doi:10.1108/BFJ-08-2015-0274.
- Akintoye, Akintola, and Jamie Main. 2007. "Collaborative Relationships in Construction: The UK Contractors' Perception." *Engineering, Construction and Architectural Management* 14 (6): 597–617. doi:10.1108/09699980710829049.
- Ambrose, Eamonn, Donna Marshall, and Daniel Lynch. 2010. "Buyer Supplier Perspectives on Supply Chain Relationships." *International Journal of Operations & Production Management* 30 (12): 1269–1290. doi:10.1108/01443571011094262.
- Arndt, Tobias, Mukesh Kumar, Gisela Lanza, and Manoj Kumar Tiwari. 2019. "Integrated Approach for Optimizing Quality Control in International Manufacturing Networks." *Production Planning & Control* 30 (2-3): 225–238. doi:10.1080/09537287.2018.1534271.
- Arora, Amit, Anshu Saxena Arora, K. Sivakumar, and Gerard Burke. 2020. "Strategic Sustainable Purchasing, Environmental Collaboration, and Organizational Sustainability Performance: The Moderating Role of Supply Base Size." *Supply Chain Management: An International Journal* 25 (6): 709–728. doi:10.1108/SCM-07-2019-0284.
- Ashwath, P., J. Joel, M. Anthony Xavier, and H. G. Prashantha Kumar. 2018. "Effect of SiC and Al₂O₃ Particles Addition to AA 2900 and AA 2024 MMC's Synthesized through Microwave Sintering." *Materials Today: Proceedings* 5 (2): 7329–7336. doi:10.1016/j.matpr.2017.11.402.
- Barratt, Mark, and Alexander Oliveira. 2001. "Exploring the Experiences of Collaborative Planning Initiatives." *International Journal of Physical Distribution & Logistics Management* 31 (4): 266–289. doi:10.1108/09600030110394932.
- Cadden, Trevor, Guangming Cao, Ying Yang, Alan McKittrick, Ronan Mclvor, and George Onofrei. 2021. "The Effect of Buyers' Socialization Efforts on the Culture of Their Key Strategic Supplier and Its Impact on Supplier Operational Performance." *Production Planning & Control* 32 (13): 1102–1117. doi:10.1080/09537287.2020.1785574.
- Caniëls, Marjolein C. J., and Cees J. Gelderman. 2007. "Power and Interdependence in Buyer Supplier Relationships: A Purchasing Portfolio Approach." *Industrial Marketing Management* 36 (2): 219–229. doi:10.1016/j.indmarman.2005.08.012.
- Cantwell, Dick. 2013. *The Brewers Association's Guide to Starting Your Own Brewery*. Boulder, CO: Brewers Publications.
- Cao, Mei, Mark A. Vonderembse, Qingyu Zhang, and T. S. Ragu-Nathan. 2010. "Supply Chain Collaboration: Conceptualisation and Instrument Development." *International Journal of Production Research* 48 (22): 6613–6635. doi:10.1080/00207540903349039.
- Cao, Mei, and Qingyu Zhang. 2011. "Supply Chain Collaboration: Impact on Collaborative Advantage and Firm Performance." *Journal of*

- Operations Management* 29 (3): 163–180. doi:10.1016/j.jom.2010.12.008.
- Chen, Yen-Chun, Yung-Cheng Shen, Crystal Tzu-Ying Lee, and Fu-Kai Yu. 2017. "Measuring Quality Variations in E-Service." *Journal of Service Theory and Practice* 27 (2): 427–452. doi:10.1108/JSTP-03-2015-0063.
- Cousins, Paul D., and Bulent Menguc. 2006. "The Implications of Socialization and Integration in Supply Chain Management." *Journal of Operations Management* 24 (5): 604–620. doi:10.1016/j.jom.2005.09.001.
- Danloup, Nicolas, Vahid Mirzabeiki, Hamid Allaoui, Gilles Goncalves, Denyse Julien, and Carlos Mena. 2015. "Reducing Transportation Greenhouse Gas Emissions with Collaborative Distribution." Edited by Prof Hamid Allaoui, Dr. Alok Choudhary." *Management Research Review* 38 (10): 1049–1067. doi:10.1108/MRR-11-2014-0262.
- Darestani, Soroush Avakh, Hadi Ghaderi, Zulkiffle Leman, and Mohd Yusof Ismail. 2012. "Horizontal Collaboration in Logistics: A Feasible Task for Group Purchasing." *International Journal of Procurement Management* 5 (1): 43. doi:10.1504/IJPM.2012.044153.
- Defernez, M., R. J. Foxall, C. J. O'Malley, G. Montague, S. M. Ring, and E. K. Kemsley. 2007. "Modelling Beer Fermentation Variability." *Journal of Food Engineering* 83 (2): 167–172. doi:10.1016/j.jfoodeng.2007.02.033.
- Duhaylongsod, Jose Benedicto, and Pietro De Giovanni. 2019. "The Impact of Innovation Strategies on the Relationship between Supplier Integration and Operational Performance." *International Journal of Physical Distribution & Logistics Management* 49 (2): 156–177. doi:10.1108/IJPDLM-09-2017-0269.
- Eisenhardt, K. M. 1989. "Building Theories from Case Study." *Academy of Management Review* 14 (4): 532–550. doi:10.5465/amr.1989.4308385.
- Eisenhardt, K. M., and M. E. Graebner. 2007. "Theory Building from Cases: Opportunities and Challenges." *Academy of Management Journal* 50 (1): 25–32. doi:10.5465/amj.2007.24160888.
- ElMaraghy, H., A. Azab, G. Schuh, and C. Pulz. 2009. "Managing Variations in Products, Processes and Manufacturing Systems." *CIRP Annals* 58 (1): 441–446. doi:10.1016/j.cirp.2009.04.001.
- Eng, Teck-Yong. 2005. "The Influence of a Firm's Cross-Functional Orientation on Supply Chain Performance." *The Journal of Supply Chain Management* 41 (4): 4–16. doi:10.1111/j.1745-493X.2005.04104002.x.
- Forster, A., and A. Gahr. 2013. "On the Fate of Certain Hop Substances during Dry Hopping." *BrewingScience* 66: 94–103.
- Fu, Shaoling, Yuanzhu Zhan, Jun Ouyang, Yalan Ding, Kim Hua Tan, and Lingmei Fu. 2020. "Power, Supply Chain Integration and Quality Performance of Agricultural Products: Evidence from Contract Farming in China." *Production Planning and Control* 32 (13): 1119–1135. doi:10.1080/09537287.2020.1794074.
- Gellynck, Xavier, and Kühne Bianka. 2010. "Horizontal and Vertical Networks for Innovation in the Traditional Food Sector." *International Journal of Food System Dynamics* 2: 123–132. doi:10.18461/IJFSD.V112.124.
- Gimenez, Cristina, Taco van der Vaart, and Dirk Pieter van Donk. 2012. "Supply Chain Integration and Performance: The Moderating Effect of Supply Complexity." *International Journal of Operations & Production Management* 32 (5): 583–610. doi:10.1108/01443571211226506.
- Goffin, Keith, Fred Lemke, and Marek Szwajczewski. 2006. "An Exploratory Study of 'Close' Supplier-Manufacturer Relationships." *Journal of Operations Management* 24 (2): 189–209. doi:10.1016/j.jom.2005.05.003.
- Hingley, Martin, Adam Lindgreen, David B. Grant, and Charles Kane. 2011. "Using Fourth-Party Logistics Management to Improve Horizontal Collaboration among Grocery Retailers." *Supply Chain Management: An International Journal* 16 (5): 316–327. doi:10.1108/13598541111155839.
- Huang, Yuan, Weixi Han, and Douglas K. Macbeth. 2020. "The Complexity of Collaboration in Supply Chain Networks." *Supply Chain Management: An International Journal* 25 (3): 393–410. doi:10.1108/SCM-11-2018-0382.
- Hudnurkar, Manoj, and Urvashi Rathod. 2017. "Collaborative Practices with Suppliers in Indian Manufacturing Multinationals." *Journal of Global Operations and Strategic Sourcing* 10 (2): 206–231. doi:10.1108/JGOSS-07-2016-0022.
- Hudson, Mel, Andi Smart, and Mike Bourne. 2001. "Theory and Practice in SME Performance Measurement Systems." *International Journal of Operations & Production Management* 21 (8): 1096–1115. doi:10.1108/EUM0000000005587.
- Johnston, Robert, and Roy Staughton. 2009. "Establishing and Developing Strategic Relationships – The Role for Operations Managers." *International Journal of Operations & Production Management* 29 (6): 564–590. doi:10.1108/01443570910957564.
- Kim, Soo Wook, and Ram Narasimhan. 2002. "Information System Utilization in Supply Chain Integration Efforts." *International Journal of Production Research* 40 (18): 4585–4609. doi:10.1080/0020754021000022203.
- Kotzab, Herbert, Christoph Teller, David B. Grant, and Leigh Sparks. 2011. "Antecedents for the Adoption and Execution of Supply Chain Management." *Supply Chain Management: An International Journal* 16 (4): 231–245. doi:10.1108/13598541111139053.
- Kumar, Nirmalya. 1996. "The Power of Trust in Manufacturer –Retailer Relationships." *Harvard Business Review* Nov–Dec, 92–106.
- Leat, Philip, and Cesar Revoredo-Giha. 2013. "Risk and Resilience in Agri-Food Supply Chains: The Case of the ASDA PorkLink Supply Chain in Scotland." *Supply Chain Management: An International Journal* 18 (2): 219–231. doi:10.1108/13598541311318845.
- Liu, Chen, Baofeng Huo, Shulin Liu, and Xiande Zhao. 2015. "Effect of Information Sharing and Process Coordination on Logistics Outsourcing." *Industrial Management & Data Systems* 115 (1): 41–63. doi:10.1108/IMDS-08-2014-0233.
- Luo, Wen, Yangyan Shi, and V. G. Venkatesh. 2018. "Exploring the Factors of Achieving Supply Chain Excellence: A New Zealand Perspective." *Production Planning & Control* 29 (8): 655–667. doi:10.1080/09537287.2018.1451004.
- MacKay, R. Jock, and Stefan H. Steiner. 1997. "Strategies for Variability Reduction." *Quality Engineering* 10 (1): 125–136. doi:10.1080/08982119708919115.
- Mandal, Santanu, and Rajneesh Ranjan Jha. 2018. "Exploring the Importance of Collaborative Assets to Hospital-Supplier Integration in Healthcare Supply Chains." *International Journal of Production Research* 56 (7): 2666–2683. doi:10.1080/00207543.2017.1381349.
- Manley, T. Roger, Wade H. Shaw, and Robert C. Manley. 2007. "Project Partnering: A Medium for Private and Public Sector Collaboration." *Engineering Management Journal* 19 (2): 3–11. doi:10.1080/10429247.2007.11431726.
- MAPA. 2018. "A Cerveja No Brasil." Ministério Da Agricultura, Pecuária e Abastecimento. <http://www.agricultura.gov.br/assuntos/inspecao/produtos-vegetal/a-serveja-no-brasil>.
- Matopoulos, A., M. Vlachopoulou, V. Manthou, and B. Manos. 2007. "A Conceptual Framework for Supply Chain Collaboration: Empirical Evidence from the Agri-Food Industry." *Supply Chain Management: An International Journal* 12 (3): 177–186. doi:10.1108/13598540710742491.
- McAdam, Maura, Rodney McAdam, Adele Dunn, and Clare McCall. 2014. "Development of Small and Medium-Sized Enterprise Horizontal Innovation Networks: UK Agri-Food Sector Study." *International Small Business Journal: Researching Entrepreneurship* 32 (7): 830–853. doi:10.1177/0266242613476079.
- Meng, Xianhai. 2020. "Proactive Management in the Context of Construction Supply Chains." *Production Planning & Control* 31 (7): 527–539. doi:10.1080/09537287.2019.1657977.
- Moradlou, Hamid, Sam Roscoe, and Abhijeet Ghadge. 2020. "Buyer-Supplier Collaboration during Emerging Technology Development." *Production Planning & Control* 1–16. doi:10.1080/09537287.2020.1810759.
- Nyaga, Gilbert N., Daniel F. Lynch, Donna Marshall, and Eamonn Ambrose. 2013. "Power Asymmetry, Adaptation and Collaboration in Dyadic Relationships Involving a Powerful Partner." *Journal of Supply Chain Management* 49 (3): 42–65. doi:10.1111/jscm.12011.
- Parker, Daniel, Michael Taylor, Julio Romero Johnson, and Keith Robert Thomas. 2019. "British Beer Styles. Where Are They Heading?" *British Food Journal* 122 (1): 60–74. doi:10.1108/BFJ-12-2018-0842.

- Paulraj, Antony, Augustine A. Lado, and Injazz J. Chen. 2008. "Inter-Organizational Communication as a Relational Competency: Antecedents and Performance Outcomes in Collaborative Buyer-Supplier Relationships." *Journal of Operations Management* 26 (1): 45–64. doi:10.1016/j.jom.2007.04.001.
- Pellettieri, Mary. 2015. *Quality Management Essential Planning for Breweries*. Colorado: Brewers Publications.
- Petersen, Kenneth J., Robert B. Handfield, and Gary L. Ragatz. 2005. "Supplier Integration into New Product Development: Coordinating Product, Process and Supply Chain Design." *Journal of Operations Management* 23 (3-4): 371–388. doi:10.1016/j.jom.2004.07.009.
- Poberschnigg, Tayanne Ferraz da Silva, Marcio Lopes Pimenta, and Per Hilletoft. 2020. "How Can Cross-Functional Integration Support the Development of Resilience Capabilities? The Case of Collaboration in the Automotive Industry." *Supply Chain Management: An International Journal* 25 (6): 789–801. doi:10.1108/SCM-10-2019-0390.
- Pomponi, Francesco, Luciano Fratocchi, and Silvia Rossi Tafuri. 2015. "Trust Development and Horizontal Collaboration in Logistics: A Theory Based Evolutionary Framework." *Supply Chain Management: An International Journal* 20 (1): 83–97. doi:10.1108/SCM-02-2014-0078.
- Poveda, J. M. 2019. "Biogenic Amines and Free Amino Acids in Craft Beers from the Spanish Market: A Statistical Approach." *Food Control* 96: 227–233. doi:10.1016/j.foodcont.2018.09.012.
- Prajogo, Daniel, and Jan Olhager. 2012. "Supply Chain Integration and Performance: The Effects of Long-Term Relationships, Information Technology and Sharing, and Logistics Integration." *International Journal of Production Economics* 135 (1): 514–522. doi:10.1016/j.ijpe.2011.09.001.
- Ramanathan, Usha, Erica Mazzola, Usha Mohan, Manfredi Bruccoleri, Anjali Awasthi, and Jose Arturo Garza-Reyes. 2020. "How Selection of Collaborating Partners Impact on the Green Performance of Global Businesses? An Empirical Study of Green Sustainability." *Production Planning and Control* 0 (0): 1–16. doi:10.1080/09537287.2020.1796133.
- Rota, Cosimo, Nikolai Reynolds, and Cesare Zanasi. 2013. "Sustainable Food Supply Chains: The Role of Collaboration and Sustainable Relationships." *International Journal of Business and Social Science* 4 (4): 45–54.
- Salimian, Hamid, Mona Rashidirad, and Ebrahim Soltani. 2021. "Supplier Quality Management and Performance: The Effect of Supply Chain Oriented Culture." *Production Planning & Control* 32 (11): 942–917. July. doi:10.1080/09537287.2020.1777478.
- Saunders, Mark, Philip Lewis, and Adrian Thornhill. 2016. *Research Methods for Business Students*. Harlow: Pearson.
- Scholten, Kirstin, and Sanne Schilder. 2015. "The Role of Collaboration in Supply Chain Resilience." *Supply Chain Management: An International Journal* 20 (4): 471–484. doi:10.1108/SCM-11-2014-0386.
- Scholten, Kirstin, Pamela Sharkey Scott, and Brian Fynes. 2019. "Building Routines for Non-Routine Events: Supply Chain Resilience Learning Mechanisms and Their Antecedents." *Supply Chain Management: An International Journal* 24 (3): 430–442. doi:10.1108/SCM-05-2018-0186.
- Schulze-Ehlers, Birgit, Nina Steffen, Gesa Busch, and Achim Spiller. 2014. "Supply Chain Orientation in SMEs as an Attitudinal Construct." *Supply Chain Management: An International Journal* 19 (4): 395–412. doi:10.1108/SCM-07-2013-0241.
- Soosay, Claudine Antoinette, and Paul Hyland. 2015. "A Decade of Supply Chain Collaboration and Directions for Future Research." *Supply Chain Management: An International Journal* 20 (6): 613–630. doi:10.1108/SCM-06-2015-0217.
- Spedding, Gary. n.d. "Best Practices Guide to Quality Craft Beer." <https://www.brewersassociation.org/educational-publications/best-practices-guide/>.
- Stuart, I., D. McCutcheon, R. Handfield, R. McLachlin, and D. Samson. 2002. "Effective Case Research in Operations Management: A Process Perspective." *Journal of Operations Management* 20 (5): 419–433. doi:10.1016/S0272-6963(02)00022-0.
- Suzuki, Koji. 2011. "125th Anniversary Review: Microbiological Instability of Beer Caused by Spoilage Bacteria." *Journal of the Institute of Brewing* 117 (2): 131–155. doi:10.1002/j.2050-0416.2011.tb00454.x.
- Towers, Neil, and Bernard Burnes. 2008. "A Composite Framework of Supply Chain Management and Enterprise Planning for Small and Medium-Sized Manufacturing Enterprises." *Supply Chain Management: An International Journal* 13 (5): 349–355. doi:10.1108/13598540810894933.
- Transchel, Sandra, Saurabh Bansal, and Mrinmay Deb. 2016. "Managing Production of High-Tech Products with High Production Quality Variability." *International Journal of Production Research* 54 (6): 1689–1707. doi:10.1080/00207543.2015.1053579.
- Tsanos, Christos, Konstantinos G. Zografos, and Alan Harrison. 2014. "Developing a Conceptual Model for Examining the Supply Chain Relationships between Behavioural Antecedents of Collaboration, Integration and Performance." *The International Journal of Logistics Management* 25 (3): 418–462. doi:10.1108/IJLM-02-2012-0005.
- Voss, Chris, Nikos Tsikriktsis, and Mark Frohlich. 2002. "Case Research in Operations Management." *International Journal of Operations & Production Management* 22 (2): 195–219. doi:10.1108/01443570210414329.
- Wang, Ching-Hsin, Kuen-Suan Chen, and Kim-Hua Tan. 2019. "Lean Six Sigma Applied to Process Performance and Improvement Model for the Development of Electric Scooter Water-Cooling Green Motor Assembly." *Production Planning & Control* 30 (5-6): 400–412. doi:10.1080/09537287.2018.1501810.
- Warsanga, William Barnos. 2014. "Coordination and Structure of Agri-Food Value Chains: Analysis of Banana Value Chain Strands in Tanzania." *Journal of Economic and Sustainable Development* 5 (7): 71–78.
- Whipple, Judith M., and Russell Dawn. 2007. "Building Supply Chain Collaboration: A Typology of Collaborative Approaches." *The International Journal of Logistics Management* 18 (2): 174–196. doi:10.1108/09574090710816922.
- Wieland, A., and C. M. Wallenburg. 2013. "The Influence of Relational Competencies on Supply Chain Resilience: A Relational View." *International Journal of Physical Distribution & Logistics Management* 43 (4): 300–320. doi:10.1108/IJPDLM-08-2012-0243.
- Williams, Brent D., Joseph Roh, Travis Tokar, and Morgan Swink. 2013. "Leveraging Supply Chain Visibility for Responsiveness: The Moderating Role of Internal Integration." *Journal of Operations Management* 31 (7-8): 543–554. doi:10.1016/j.jom.2013.09.003.
- Wong, Christina W. Y., Kee-hung Lai, and Edward W. N. Bernroider. 2015. "The Performance of Contingencies of Supply Chain Information Integration: The Roles of Product and Market Complexity." *International Journal of Production Economics* 165: 1–11. doi:10.1016/j.ijpe.2015.03.005.
- Yin, Robert K. 2008. *Case Study Research: Design and Method*. Sage Publications, Inc. 4th ed. Los Angeles: Sage Publications.
- Yu, Yubing, Min Zhang, and Baofeng Huo. 2020. "The Impact of Relational Capital on Green Supply Chain Management and Financial Performance." *Production Planning and Control* 32 (10): 861–874. doi:10.1080/09537287.2020.1774675.
- Zaridis, A., I. Vlachos, and M. Bourlakis. 2020. "SMEs Strategy and Scale Constraints Impact on Agri-Food Supply Chain Collaboration and Firm Performance." *Production Planning and Control* 32 (14): 1165–11178. doi:10.1080/09537287.2020.1796136.
- Zhang, Dongli, Kevin Linderman, and Roger Schroeder. 2012. "The Moderating Role of Contextual Factors on Quality Management Practices." *Journal of Operations Management* 30 (1-2): 12–23. doi:10.1016/j.jom.2011.05.001.
- Zhang, Zhe, Samuel B. Godefroy, Hanyang Lyu, Baoguo Sun, and Yongxiang Fan. 2018. "Transformation of China's Food Safety Standard Setting System – Review of 50 Years of Change, Opportunities and Challenges Ahead." *Food Control* 93: 106–111. doi:10.1016/j.foodcont.2018.05.047.
- Zhao, Xiande, Baofeng Huo, Barbara B. Flynn, and Jeff Hoi Yan Yeung. 2008. "The Impact of Power and Relationship Commitment on the Integration between Manufacturers and Customers in a Supply Chain." *Journal of Operations Management* 26 (3): 368–388. doi:10.1016/j.jom.2007.08.002.

Appendix

Appendix A. Interview protocol

Company:

Name:

Position and experience:

Production volume per month:

Answer questions below indicating any evolution in your company over the last three years and how it happens (if there was any influence from internal and external players).

1. How do you manage variations in raw materials acquired (malted barley, hops, and yeast)?
2. How do you manage variations in the water components?
3. How do you manage variations in the milling of the grain?
4. How do you manage temperature and time variations in the mash conversion process?
5. How do you manage variations in the lautering process?
6. How do you manage variations in the boiling process?

7. How do you control variations of temperature, pressure and time in the cooling?
8. How do you control variations in the fermentation process?
9. How do you manage variations in the maturation, filtration or centrifuge, carbonation, cellaring, pasteurisation, and process transferring?
10. What kind of tests are performed to guarantee the final product quality?
11. What kind of tests are performed to guarantee sterilisation and asepsis quality?
12. What manufacturing practices support process quality (5S, best manufacturing practices, standard operational procedure, six sigma, total quality management)? How were they implemented?
13. How have your manufacturing technologies helped reduce any variability during the process (manual vs automatic, lab)?

Could you provide your information for future contact?