Abstract

Purpose – This study contributes to our understanding of the relationship between information sharing and performance of perishable product supply chains (PPSC). Building on transaction cost economics (TCE), organisational information processing theory (OIPT), and contingency theory (CT) this study proposes a theoretical framework to guide future research into information sharing in perishable product supply chains (IS-PPSC).

Design/methodology/approach – Using the systematic literature review methodology, 48 peer-reviewed articles are carefully selected, mapped, and assessed. Template analysis is performed to unravel the relationship mechanisms between information sharing and PPSC performance.

Findings – We find that the relationship between information sharing and PPSC performance is currently unclear and there is inconsistency in the positioning of information sharing among constructs and variables in the IS-PPSC literature. This implies a requirement to refine the relationship between information sharing and PPSC performance. The review also revealed that the role of perishable product characteristics has largely been ignored in existing research.

Originality/value – This study applies relevant multiple theoretical perspectives to overcome the ambiguity of the IS-PPSC literature and contributes nine propositions to guide future research. Accordingly, this study contributes to the refined roles of relationship uncertainty, environmental uncertainty, information sharing capabilities, and perishable product characteristics in shaping the relationship between information sharing and PPSC performance.

Keywords – Information sharing, Perishability, Asset specificity, Relationship uncertainty, Environmental uncertainty, Product vulnerability, Product criticality, Template analysis

Paper type Literature review

Introduction

Perishable products are defined as products whose quality deteriorates over time (Karaesmen *et al.,* 2011). Products such as fruit, vegetables, meat, poultry, dairy products, pharmaceuticals and human blood can be categorised as perishable products (Karaesmen *et al.,* 2011; Ferguson and Ketzenberg, 2006). Products vulnerability varies, with some more susceptible to contamination by disease and damage by unpredictable weather, thus making it difficult to guarantee quality standards and product availability (Clements *et al.*, 2008). Management of the perishable product supply chain (PPSC) is particularly complex due to the uncertainty of demand, the variability of short shelf lives, and high deterioration rates, requiring special storage conditions to slow the rate of decay (Van Donselaar *et al*., 2006; Ferguson and Ketzenberg, 2006). Storing perishable products for long periods of time without proper storage facilities will adversely affect the quality and safety of these products and in some cases make them dangerous for human consumption. Typically, spoiled products can no longer be used or recycled and are

wasted with environmental and cost consequences (Kaipia *et al.*, 2013). This leads Turnbull (1989) to suggest that managing perishable products requires a coordinated supply chain to maintain high quality and customer service levels in a short shelf life environment.

A considerable amount of research has been dedicated to specifically tackling challenges in perishable inventory management (e.g. Nahmias, 1982; Raafat, 1991) and has highlighted information sharing as an important means of reducing complexity and improving the performance of the PPSC (Clements *et al.*, 2008; Ferguson and Ketzenberg, 2006). Information sharing is widely defined as inter-organisational communication, i.e. "the extent to which critical, often proprietary, information is communicated to one's partner" (Mohr and Spekman, 1994:139). Alternatively, it has been defined as a traceability system that "facilitates dissemination of information among supply chain partners for the purpose of improving the satisfaction of the ultimate customers of the supply chain" (Zelbst *et al*., 2010:583). Sharing information can reduce uncertainty in demand and supply and significantly improve supply chain service levels, decrease inventory levels, lower stock outs, increase product freshness, and greatly reduce product wastage due to time expiry (Ferguson and Ketzenberg, 2006; Kaipia *et al*., 2013). In the PPSC context, information sharing is particularly critical due to the need for extensive control and monitoring of the quality and safety of perishable products across the supply chain (Shi *et al*., 2010; Salin, 1998). Ultimately, information sharing can help improve decision making and minimise cost across the PPSC (Shi *et al*., 2010).

Despite the claimed benefits that are widely discussed across the supply chain management literature (e.g. Cachon and Fisher, 2000; Fawcett *et al*., 2007; Lee *et al.,* 2000), a common understanding of the relationship between information sharing and PPSC performance has not been achieved. Whilst some researchers contend that it is known that information sharing has a direct impact on PPSC performance (e.g., Ketzenberg *et al*., 2015; Kottila, 2009), others suggest that the relationship is more complicated and a deeper understanding of the dimensions that moderate or mediate the relationship is required (e.g., Peng *et al.*, 2012; Peng *et al.*, 2014; Kaipia *et al.*, 2013). While some have specifically measured PPSC performance using inventory costs (Ketzenberg *et al*., 2015), product availability, waste, and shelf life (Kaipia *et al.*, 2013), others do not specify what they mean by performance in the PPSC context (e.g. Nakandala *et al*., 2017; Kottila, 2009).

In addition, the critical role of perishable product characteristics in shaping the relationship between information sharing and PPSC performance remains unclear.

Ferguson and Ketzenberg (2006) find that the benefits of information sharing are highest when product lifetime is short; suggesting that product perishability can strengthen the relationship between information sharing and PPSC performance. In contrast, Wong *et al*. (2011) argue that information sharing is beneficial to gaining operational efficiency and satisfying customer needs regardless of the level of product perishability. Given these contradictory arguments, the extant literature calls for more investigation into the relationship between product perishability, information sharing, and supply chain performance for industries with specific logistical requirements (Wong *et al*., 2011).

This study contributes to the extant literature, by exploring the phenomenon of information sharing in the context of perishable product supply chains (IS-PPSC) to answer the following questions:

1. *How does information sharing influence PPSC performance?*
2. *What is the role of perishable product characteristics in the relationship between information sharing and PPSC performance?*

This paper proposes an initial framework of IS-PPSC using three theoretical perspectives – transaction cost economics (TCE), organisational information processing theory (OIPT), and contingency theory (CT). Using the systematic literature review (SLR) methodology, 48 IS-PPSC peer-reviewed articles, from an interdisciplinary range of journals, written in the last 15 years are then carefully selected, mapped, and assessed. Accordingly, template analysis is performed to unravel the relationship between information sharing and PPSC performance by identifying primary dimensions, secondary dimensions, antecedents, consequences, moderating dimensions, and mediating dimensions of IS-PPSC.

We find that there is inconsistency in the positioning of information sharing among the constructs and variables identified in the IS-PPSC literature. This suggests that the relationship between information sharing and PPSC performance remains inadequately defined and is more complicated than the theory suggests. In addition, while this study has strictly limited the scope of review to the PPSC context, we find that the role of the distinctive characteristics of perishable products has been largely ignored in existing research. To address these findings, building on TCE, OIPT, and CT, we refine our initial framework which characterises the role of relationship uncertainty, environmental uncertainty, information sharing capabilities, and perishable product characteristics in shaping the relationship between information sharing and PPSC performance. We offer eight novel and testable propositions, designed as a call to future research in this important subject area.

We postulate that high relationship/asset-specific investment does not necessarily lead PPSC actors to share information and therefore improve performance (proposition 1). Relationship and environmental uncertainties mediate and at the same time moderate the relationship between information sharing and PPSC performance (propositions 2 – 6). Furthermore, we propose that the benefits of information sharing are contingent on perishable product characteristics, such as shelf life (proposition 6a), vulnerability (proposition 6b) and criticality of the product (proposition 6c). Finally, information sharing capabilities can be a mediating construct and at the same time an antecedent of IS-PPSC (propositions 7 and 8). Increasing the relationship/asset specific investment leads to increased information sharing capabilities and therefore PPSC performance (proposition 9).

This paper is organised as follows. An introduction to the research has been presented in this section. The following section presents the research method with an initial framework of IS-PPSC that is drawn upon TCE, OIPT, and CT. We then describe and discuss the findings and propose a refined theoretical framework for IS-PPSC with a set of associated propositions. Finally, we conclude the paper.

Research Method

A systematic literature review (SLR) is adopted in this paper to select, map, and assess the existing studies on IS-PPSC. SLR was originally proposed in 2001 by the NHS Centre for Reviews and Dissemination; this method covers the identification of research areas, selection of studies, quality assessment, data extraction and data synthesis (Tranfield *et al*., 2003). SLR provides rigorous and transparent processes for conducting a review, inclusivity of relevant studies, explanatory or interpretive findings, and heuristic outputs that lead to the next stage of research (Denyer and Tranfield, 2009). These processes distinguish SLR from other literature review techniques that frequently lack rigour and audit trail, leading to biased results (Denyer and Tranfield, 2009).

While this method has been widely adopted across different disciplines ranging from medicine to management studies, research paradigm idiosyncrasies (i.e. different ways of defining and understanding a phenomenon) need to be taken into account when applying SLR in the supply chain management (SCM) context (Durach *et al.*, 2017). These idiosyncrasies reflect a complex range of theoretical perspectives, units of analysis, sources of data, study contexts, definitions and operationalisation of constructs, and research methods applied in SCM studies which make the retrieval, selection, and synthesis of SCM literature challenging (Durach *et al.*, 2017). Therefore, building on Tranfield *et al*. (2003), the aim of SLR in SCM is to refine existing theory of a supply

chain phenomenon by addressing these idiosyncrasies in SCM studies. In this study, the six steps for conducting an SLR in SCM proposed by Durach *et al.* (2017) are adopted and shown as subsection headings below.

Develop an initial theoretical framework of IS-PPSC (step 1)

The phenomenon of information sharing in supply chains can be understood using various theoretical perspectives (Kembro *et al.*, 2014). In this study, we use three related theories to develop an initial framework of IS-PPSC; transaction cost economics (TCE), organisational information processing theory (OIPT), and contingency theory (CT). These theories are chosen for two reasons. Firstly, while originally proposed for an organisational context (Williamson, 1985, 1981; Galbraith, 1974; Fiedler, 1964), there is growing interest in adopting these theories to explain information sharing phenomena in the supply chain context (Kembro *et al.*, 2014). In fact, TCE, OIPT, and CT are among the most commonly applied theories used to study information sharing in supply chains (Kembro *et al.*, 2014). Secondly, these theories have been used previously to capture the importance of product characteristics as a source of uncertainty in shaping the relationship between information sharing and supply chain performance (Yigitbasioglu, 2010; Premkumar *et al.*, 2005; Wong *et al.*, 2011). Therefore, they are relevant theories for addressing our research questions.

For the purpose of developing an initial theoretical framework, following Durach *et al.* (2017), we identify theoretically based articles that are closely related to our phenomenon of interest (i.e. IS-PPSC). Whilst research adopting TCE, OIPT, or CT to address IS-PPSC is scarce, we examine articles that adopt TCE, OIPT, or CT to address information sharing and the importance of product characteristics (including product perishability) in the wider supply chain management context. Most of these articles are identified by Kembro *et al.* (2014), who studied the application of theoretical perspectives to information sharing in supply chains using SLR. We identify one TCE-adopting article (Yigitbasioglu, 2010), two OIPT-adopting articles (Premkumar *et al.*, 2005; Kim *et al.*, 2005), and one CT-adopting article (Wong *et al.*, 2011). Our initial theoretical framework is based on these articles.

TCE posits that transaction costs are higher when asset specificity and uncertainty are high (Williamson, 1985). Transaction costs are formed of coordination costs (i.e. the costs of sharing and incorporating information into the decision making process) and transaction risk (i.e. the risk of opportunistic behaviour following the transaction) (Clemons *et al.*, 1993). Asset specificity refers to relationship-specific investments to support a given transaction, such as investments in an information system that is tailored

to a specific customer need (Grover and Malhotra, 2003). Finally, uncertainty refers to unexpected conditions affecting a transaction, this can be both environmental (e.g. changes in technology and demand) and behavioural uncertainty (e.g. asymmetry in information sharing between parties in a transaction) (Grover and Malhotra, 2003).

Using TCE in the supply chain context, Yigitbasioglu (2010) finds that uncertainty positively affects the intensity of information sharing between buyers and suppliers, and by extension, supply chain performance. Uncertainty, in this case, refers to environmental uncertainty (i.e. supplier actions, customer demands, macroeconomic factors), demand uncertainty (i.e. demand profile, the rate of product introductions), and relationship uncertainty (i.e. asset-specific investments, the degree of dependency amongst supply chain actors). They further test whether companies in the later stage of product life cycle are more likely to share information and find that product lifecycle positively but not significantly affects the intensity of information sharing between buyers and suppliers and therefore supply chain performance. Following Beamon (1999), supply chain performance is measured using output, resources, and flexibility performance. Output measures focus on achieving a high level of customer service; resource measures are designed to achieve high levels of efficiency; whereas flexibility measures are used to assess the ability of supply chain actors to respond to a changing environment.

Uncertainty is also a central tenet in OIPT. According to OIPT, the need to share information is positively driven by relationship uncertainty (i.e. relationship/asset-specific investments) and environmental uncertainty (i.e. technology uncertainty, demand uncertainty, supply uncertainty, product complexity, and product criticality) (Premkumar *et al.*, 2005). OIPT posits that the need to share information should be supported by suitable information sharing capabilities. These are defined by Premkumar *et al.* (2005) as levels of IT-supported information sharing mechanisms ranging from telephone to web-based interfaces. The degree of fit or interaction between information sharing needs and these capabilities then leads to improved organisational performance (Premkumar *et al.*, 2005). In the supply chain context, Kim *et al.* (2005) call for further investigation, arguing that information sharing between buyer and supplier is positively and significantly associated with product characteristics (i.e. product complexity-in-use). The more complex is the product, the more information sharing is required to coordinate supply chain partners. According to OIPT, sharing sufficient information to address this product complexity leads to improved supply chain operational efficiency.

On the other hand, CT holds that the structure of organisations should adapt flexibly to changing contextual factors to achieve high organisational performance (Donaldson, 2001). These contextual factors can include but are not limited to environmental uncertainty (Reed *et al.*, 1996) and situational uncertainty (e.g. task uncertainty – Sitkin *et al*., 1994). Consequently, organisations should be designed to respond to these uncertainties (Sousa and Voss, 2008). The principal argument of CT is that there is no best way of designing organisations; organisational design can be effective in some situations, but may not be effective in others. The optimal organisational design is contingent upon various internal and external factors (Fiedler, 1964).

In the supply chain context, Wong *et al.* (2011) use CT to propose that uncertainty is a contingency factor that moderates the relationship between information sharing and supply chain performance. According to Wong *et al.* (2011), the impact of information sharing on performance is contingent on both external environmental conditions (e.g., increase in demand, sales fluctuation, unpredictable market response) and internal operating characteristics such as product perishability. From a CT perspective, information sharing leads to better performance when supply chain actors operate under less uncertain environmental conditions while at the same time offering more complex but less perishable products to customers (Wong *et al.*, 2011).

In summary, TCE, OIPT, and CT agree on the importance of relationship uncertainty, environmental uncertainty, and product characteristics in shaping the relationship between information sharing and supply chain performance. Combining these theories allows us to capture the distinct relationship mechanisms proposed by each theory, this concurs with Kembro *et al.*'s (2014) recommendation for the use of multiple theoretical perspectives to comprehensively understand the phenomenon of information sharing in supply chains. Figure 1 shows the relationship between these constructs that serves as an initial theoretical framework of IS-PPSC.

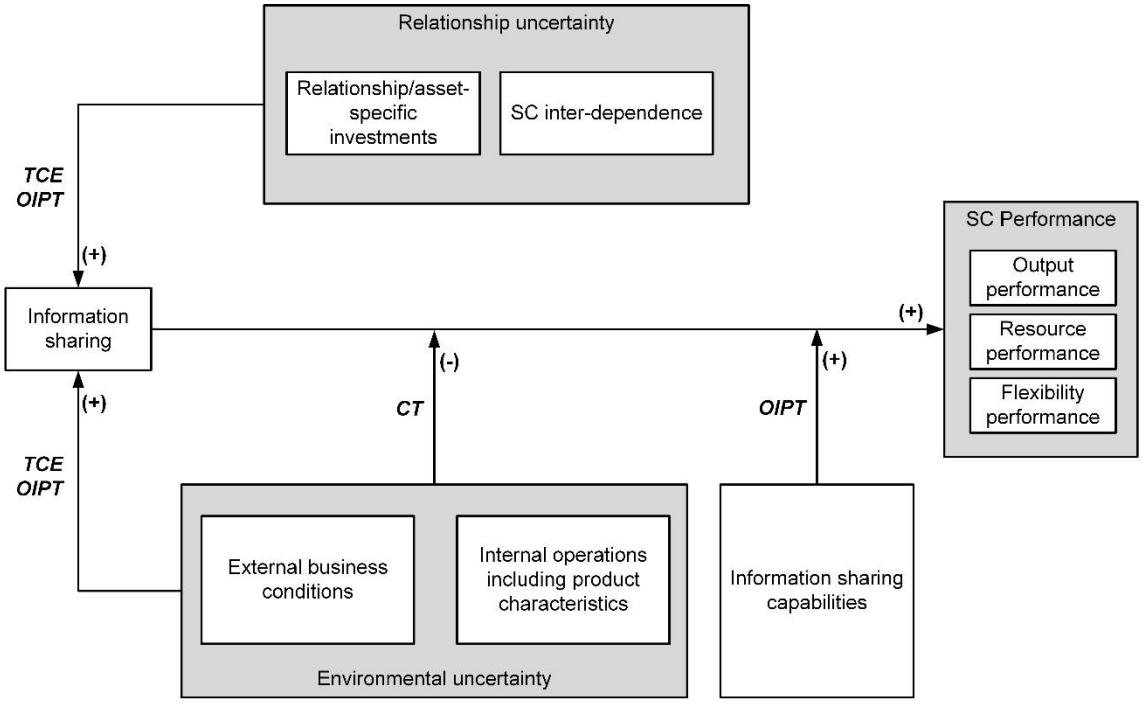

Figure 1. Initial theoretical framework of IS-PPSC based on TCE, OIPT, and CT perspectives

Develop inclusion and quality assessment criteria (step 2)

To capture the phenomenon of information sharing in perishable product supply chains (IS-PPSC) and to ensure the rigour of the SLR, we develop inclusion and quality assessment criteria. We develop two sets of inclusion criteria for title and abstract screening, and full-text screening (Denyer and Tranfield, 2009), (see Table 1). For an article to be included, all the criteria listed in Table 1 should have "yes" answers.

We limit our search to relevant peer-reviewed academic journal articles written in English. For the purpose of this SLR, considering rules for formulating a conceptual definition (Wacker, 2004), we define information sharing as *inter-organisational communication of meaningful data and/or explicit knowledge amongst supply chain actors.* In this definition, information can be defined as data with relevance and purpose and as knowledge that can be articulated and easily transmitted across parties (i.e. explicit knowledge – Stenmark, 2002). This definition is in line with Kembro and Näslund (2014) who suggest that information sharing covers not only sharing information but also sharing data and knowledge. In fact, Stenmark (2002) argue that data, information, and knowledge are interwoven.

Table 1. Inclusion criteria for title, abstract, and full-text screening

Title and abstract inclusion criteria	Full-text inclusion criteria
- Peer-reviewed articles? - Academic journal articles? - Written in English? - Purpose(s), finding(s), and/or implication(s) talk about IS-PPSC? - Perishable product context?	- Information sharing focus (i.e. information sharing or traceability as the main construct/variable or as a key dimension of the researched topic)? - Information sharing at inter-organisational level? - Unit of analysis covers dyadic or extended supply chain? - Data collected from dyadic or extended supply chain? - Perishable product context, i.e. addressing perishable products which have short biological life cycles, unrecyclable, directly affect human's life, and susceptible to natural or artificial (cold chain) environmental conditions where product safety and quality are paramount?

While we acknowledge the importance of intra-organisational information sharing (see Gimenez, 2006), our primary focus is on information sharing at the supply chain level, i.e. inter-organisational information sharing (IOIS) and traceability across the PPSC. We adapt Harland's (2007) definition of "supply chain management" as the management of supply relationships between two or more organisations, excluding the internal supply chain and therefore internal information sharing. As a consequence, we only select articles examining information sharing in dyadic or extended supply chains as the unit of analysis. Accordingly, we also strictly select articles that derive their analysis from data collected from two or more supply chain actors. By doing this, consistent with Durach *et al.*'s (2017) recommendation, we attempt to maintain comparable units of analysis and units of data collection; avoiding bias in synthesising the literature.

Following the majority of the PPSC literature and to address the research call of Wong *et al*. (2011), the focus of this study is on perishable products which have specific logistical requirements. This includes products that have short biological life cycles, are not recyclable, directly affect human life, are susceptible to natural or artificial (cold chain) environmental conditions and for which product safety and quality are paramount. These products include, but are not limited to fresh produce, poultry, dairy products, bakery products, human blood, and pharmaceuticals. Although pharmaceutical products include those with relatively long shelf lives, we include this class of products in their entirety due to their criticality to human life and the requirement for specialist logistical processes to maintain product safety and quality (Papert *et al*., 2016). We have striven to ensure the

generalizability of this study by including as wide a range of perishable products as possible. However, we exclude product types such as newspapers and fashion products which have short shelf life cycles but are not perishable in the sense that we discuss in this study; their safety and quality do not deteriorate due to time or environmental factors, and they do not require specialist logistical or storage conditions.

Finally, we select articles which explicitly or implicitly relate information sharing to PPSC performance. While specific measures such as product safety and quality are paramount for PPSC, a formal definition of PPSC performance is currently absent in the literature. Therefore, we do not set specific criteria for the PPSC performance measures used in IS-PPSC literature. This avoids limiting our review to a very small number of articles which would reduce the generalizability of our results.

Alongside the inclusion criteria, we develop explicit quality assessment criteria (Tranfield *et al.*, 2003). These criteria are adapted and modified from the reviewer guidelines of highly respected journals in the field of operations and logistics and supply chain management. Including *International Journal of Physical Distribution & Logistics Management, International Journal of Operations & Production Management, and International Journal of Logistics Management* (Emerald Group Publishing Reviewer Guidelines, 2016).

Consistent with Durach *et al.* (2017), due to the subject area studied, we include interdisciplinary articles with multiple methodological approaches. The authorial team and the expert panel include a diverse range of subject area and methodological expertise to reduce the risk of assessment and selection bias. Using the classification of Pilbeam *et al.* (2012), we treat studies using quantitative research techniques including mathematical modelling and simulation as analytical rather than empirical research. For these papers, we carefully examine the assumptions and limitations used to build the model. In fact, some of these papers call for further development and empirical testing of their model propositions; giving us a legitimacy to treat the results of these papers as suggestive rather than conclusive.

Identify literature through rigorous and structured searches (step 3)

We use four research databases – EBSCO, ABI/Inform, Scopus, and Web of Science – to retrieve relevant articles. This ensured the inclusion of all relevant articles and accommodated an interdisciplinary view of the topic under review. EBSCO and ABI/Inform provide literature focused on business and management, including supply chain management, whereas Scopus and Web of Science include literature from other relevant disciplines such as medicine and food science.

Table 2. Search strings and excluded keywords

Code	Formula for search strings and excluded keywords
SS-1	(data N4 share OR data N4 sharing OR data N4 shared OR data N4 exchang* OR data N4 flow* OR data N4 track* OR data N4 trace OR data N4 tracing OR data N4 traced OR data N4 transfer* OR information N4 share OR information N4 sharing OR information N4 shared OR information N4 exchang* OR information N4 flow* OR information N4 track* OR information N4 trace OR information N4 tracing OR information N4 traced OR information N4 transfer* OR knowledge N4 share OR knowledge N4 sharing OR knowledge N4 shared OR knowledge N4 exchang* OR knowledge N4 flow* OR knowledge N4 track* OR knowledge N4 trace OR knowledge N4 tracing OR knowledge N4 traced OR knowledge N4 transfer*)
SS-2	("supply chain" OR “supply network” OR "supply management" OR “supply chain management” OR logistic* OR “logistic* management” OR “demand chain” OR "demand management" OR “demand chain management” OR interorgani?ation* OR “interorgani?ation* system” OR “value chain” OR “value chain management” OR “cold chain” OR “cold chain management”)
SS-3	(perish* OR deteriorat* OR spoil* OR decay* OR “short-lived” OR “short shelf life” OR “short life” OR perish* N4 product* OR perish* N4 item* OR deteriorat* N4 product* OR deteriorat* N4 item* OR spoil* N4 product* OR spoil* N4 item* OR decay* N4 product* OR decay* N4 item* OR food* OR “fresh food*” OR “agri-food*” OR agrifood* OR “agricultural product*” OR “fresh produce*” OR vegetable* OR fruit* OR poultry OR meat OR “diary product*” OR “bakery product*” OR vaccine* OR pharmaceutical* OR drug* OR vitamin* OR medicine* OR medication* OR blood OR bloods)
EK	(logistic W1 regression*)

For each online database, search strings (SS – a combination of keywords) and excluding keywords (EK) were developed to retrieve as many papers as possible related to information sharing, supply chain, and perishability (see Table 2 for examples). The search strings were designed to not only capture a specific phrase such as “information sharing”, but also extended phrases such as “sharing perishable product information”. To reduce bias, in line with Durach *et al.* (2017), suggestions from a panel of experts consisting of an information specialist, experts in SLR, a practitioner, and academics in the area of logistics and supply chain management were also incorporated into these search strings. To capture all relevant articles, we did not limit the search by publication time.

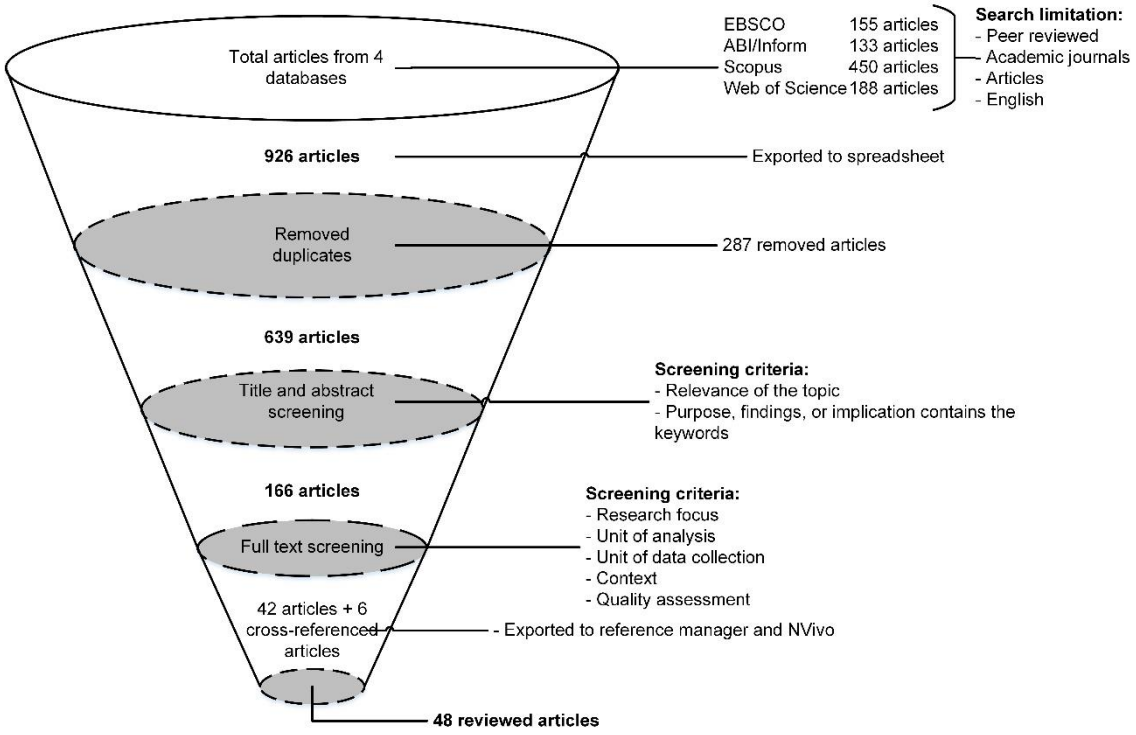

Figure 2. Data collection protocol

Identify relevant studies according to inclusion and quality assessment criteria (step 4)

By applying the inclusion and quality assessment criteria, 926 titles and abstracts were retrieved and 287 duplicates removed. Title and abstract screening was then performed for the remaining 639 articles, resulting in 166 relevant articles for full-text screening. Following this second screening, 42 articles remained including six additional articles identified through cross-referencing. In total, 48 articles published in 31 peer-reviewed academic journals across a range of disciplines (see Table 3) covering a range of research methodological approaches (73% empirical, 23% analytical, 4% literature review) passed this quality assessment, ready for analysis. Figure 2 illustrates this process.

Table 3. List of journals and the respective number of articles

Journal	Number of Articles	Journal	Number of Articles
Operations, Logistics, and Supply Chain Studies		**Business and Marketing Studies**	
International Journal of Physical Distribution & Logistics Management	5	Business Strategy and the Environment	1
Supply Chain Management: An International Journal	4	International Marketing Review	1
Production and Operations Management	3	The Journal of Applied Business Research	1
Journal on Chain and Network Science	2	Business Process Management Journal	1
Journal of Operations Management	1	Journal of Business & Industrial Marketing	1
Annals of Operations Research	1		
Interfaces	1	**Information Management**	
International Journal of Production Economics	1	Industrial Management & Data Systems	1
The International Journal of Logistics Management	1	Journal of Global Information Management	1
International Journal of Networking and Virtual Organisations	1		
		Environmental Management	
Food and Agricultural Studies		Journal of Cleaner Production	1
British Food Journal	5	Resources, Conservation and Recycling	1
Computers and Electronics in Agriculture	2		
International Food & Agribusiness Management Review	2	**Others**	
Journal of Food Engineering	2	Advanced Engineering Informatics	1
American Journal of Agricultural Economics	1	Rural Society	1
Advance Journal of Food Science and Technology	1	Therapeutic Innovation & Regulatory Science	1
Food Control	1		
Comprehensive Reviews in Food Science and Food Safety	1		
Meat Science	1		

Coding and analysis method

Forty-eight articles were coded and analysed using template analysis. King (2012) defines template analysis as a style of thematic analysis of textual data that allows a flexibility of coding structure through the use of tentative *a priori* or initial codes, which allow researchers to focus on finding relevant information from the text. Template analysis allows these initial codes to evolve by inserting, deleting, or merging codes as new themes emerge from the text. These characteristics distinguish template analysis from other approaches, such as grounded theory) which offers a more inductive and rigid coding structure that is less flexible and more time-consuming when used with large data sets (King, 2012). Moreover, in line with the purpose of this study, template analysis fits with research that seeks to understand the mechanisms of the relationship between variables (King, 2012).

The Template analysis involved several processes. First, 48 screened articles were exported to NVivo 11. Before first order coding, each article was read in detail. An *a priori* set of codes was developed to capture research questions, methodologies, findings, theoretical perspectives, logistics performance, types of perishable product, perishable product characteristics, unit of analysis, and unit of data collection. The initial template also allows the collection of detailed information on explicit and/or implicit primary dimensions, secondary dimensions, antecedents, consequences, moderating dimensions, mediating dimensions, and perishable product related variables and/or performance. This terminology, henceforth referred to as *relationship mechanisms*, reflects the different ways information sharing is positioned amongst other distinctly defined constructs or variables in the IS-PPSC literature.

Primary dimensions refer to the main constructs or variables, whereas secondary dimensions or sub-dimensions represent supporting constructs or variables studied in the reviewed literature. Secondary dimensions can also represent measurement items used to define primary dimensions. The notion of primary and secondary dimensions is adapted from Watts *et al.* (1993) as cited in D'Souza and Williams (2000), which is in line with Podsakoff *et al.* (2006) who use the term "dimensions" to cover distinct facets of constructs with their specific measures or variables. We adapt Bacharach's (1989) definition of a construct as "a broad mental configuration of a given phenomenon", whereas a variable is "an operational configuration derived from a construct". For example, performance is a construct, whereas product safety or quality is a variable representing performance. Therefore, a variable is the more concrete manifestation of a construct (Bacharach, 1989).

Antecedents in this study refer to the drivers or determinants of primary dimensions; they are constructs or variables that trigger the existence of primary dimensions. Consequences are the implications of primary dimensions. Moderating dimensions strengthen or weaken the relationship between primary dimensions and consequences, whereas mediating dimensions act as a bridge in this relationship. When mediating dimensions are taken away, the relationship between primary dimensions and consequences may not exist.

Following first order coding, second order coding grouped the initial codes into categories and higher level themes which were predetermined based on TCE, OIPT, and CT. Finally, the "final" template (see King, 2012) consisting of the first and second order codes was analysed and interpreted. The coding was initially conducted by one researcher, with input from three further researchers to ensure the consistency and

quality of the coding process. The diverse range of subject areas and methodological expertise of the research team reduced the risk of methodological or subject area bias.

Analysis and Synthesis of Literature (step 5)

To understand how information sharing influences PPSC performance, we unravel how the IS-PPSC literature addresses information sharing by mapping the relationship mechanisms that explicitly and implicitly relate to PPSC performance, see Table 4. For example, in row 1 we identify collaboration between buyers and suppliers as a central construct (i.e. primary dimension) which is explicitly addressed in the literature (Aggarwal and Srivastava, 2016). We then find that collaboration is driven by the need to share vital information (Krishnakumar *et al.*, 2009); therefore information sharing is an antecedent of collaboration. We further identify that collaboration can lead to supply chain efficiency and reduced waste (Aggarwal and Srivastava, 2016); therefore supply chain efficiency and waste are consequences of collaboration.

In row 3 we identify information sharing as a primary dimension explicitly linked to supply chain profitability as a consequence (Ferguson and Ketzenberg, 2006). We find that the shorter the product shelf life, the stronger the impact of information sharing on profitability; therefore product shelf life is considered as a moderating variable (Ferguson and Ketzenberg, 2006). We further identify that the relationship between information sharing and profitability is indirect and only exists when information sharing influences product quality compliance (e.g. the extent to which suppliers provide products to meet customers' quality requirements) (Peng *et al.*, 2012); in this case, product quality compliance is a mediating variable. This way of mapping the literature helps us to understand how IS-PPSC literature interprets the relationship between information sharing and PPSC performance.

Table 4. Positioning of IS-PPSC constructs and variables

Explicitly or implicitly mentioned in the literature?	Antecedents (number of articles)	Primary dimensions (number of articles)	Secondary dimensions (number of articles)	Moderating dimensions (number of articles)	Mediating dimensions (number of articles)	Consequences (number of articles)	Perishable product related performance (number of articles)
Explicit	Information sharing (5)	Collaboration (2), trust (1), innovation (1), transparency (1)	N/A	Technology adoption (1), information quality (1)	N/A	Profitability (2), SC efficiency (1)	Waste reduction (1), product safety (1), product quality (1)
Implicit	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Explicit	Openness (2), SC relationship (2), information quality (2), collaboration (1), costs and benefits (1), business strategy (1), regulation (1), SC network (1), problem identification (1), communication media (1), frequency of communication (1), staff involvement (1), information access (1), level of information sharing (1), position in SC (1)	Information sharing (22)	N/A	Shelf life (1), demand variability (1), product cost (1), integration focus (1), SC structure (1), information quality (1), information use (1), coordination structure (1), distance to market (1)	Spoilage (1), product availability (1), service level (1), quality compliance (1), communication quality (1),	Profitability (5), SC efficiency (2), collaboration (2), delivery (2), inventory management (2), customer satisfaction (2), sales (1), transaction cost (1), SC relationship (1), demand uncertainty (1), competitiveness (1), problem resolution (1), price decision (1), environmental cost (1)	Product quality (5), product safety (3), product availability (2), product freshness (2), outdate (2), waste (1), shelf life (1)
Implicit	Technology adoption (1)	N/A	N/A	Information quality (10), technology adoption (7), product perishability (2), market power (1), information type (1), inventory policy (1), company characteristics (1), SC relationship (1), position in SC (1), information use (1)	N/A	Service level (1), SC efficiency (1), profitability (1), yield (1), resource allocation (1), sales revenue (1), information sharing efficiency (1), inventory management (1), risk management (1)	Product safety (5), Product quality (4), product availability (3), product freshness (1)

Explicitly or implicitly mentioned in the literature?	Antecedents (number of articles)	Primary dimensions (number of articles)	Secondary dimensions (number of articles)	Moderating dimensions (number of articles)	Mediating dimensions (number of articles)	Consequences (number of articles)	Perishable product related performance (number of articles)
Explicit	Investment in information sharing system (2), technology adoption (1), openness (1)	Technology adoption (5), collaboration (2), demand management (2), SC database (2), SC practices (1), SC relationship (1), logistics solution (1), root causes of food waste (1), SC resilience (1), governance structure (1), information standard (1)	Information sharing (18)	Market power (1), SC structure (1), business process (1)	Visibility (1), velocity (1), flexibility (1)	Order management (2), demand management (2), inventory management (2), visibility (2), profitability (1), collaboration (1), competitiveness (1), market share (1), forecasting (1), internal efficiency (1), labour hired (1), SC resilience (1), , patient safety (1), revenue (1), labour savings (1), logistics efficiency (1), trust (1), size of partner network (1), SC relationship (1)	Product safety (2), product quality (1), product availability (1), waste (1)
Implicit	Openness (2), costs and benefits (1), effectiveness of information flow (1), trust (1), entrepreneurial orientation (1)	N/A	N/A	Information quality (13), technology adoption (8), perishable product characteristics (2), information use (2), procurement management (1), quality management (1), logistics functions (1), performance incentives (1), SC relationship (1)	N/A	Delivery (2), order management (2), administration cost (2), responsiveness (1), customer satisfaction (1), data generation (1), patient safety (1), SC efficiency (1), inventory management (1), transportation management (1)	Product safety (5), product quality (2), product availability (2)
Explicit	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Implicit	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 4 (continued)

Explicitly or implicitly mentioned in the literature?	Antecedents (number of articles)	Primary dimensions (number of articles)	Secondary dimensions (number of articles)	Moderating dimensions (number of articles)	Mediating dimensions (number of articles)	Consequences (number of articles)	Perishable product related performance (number of articles)
Explicit	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Implicit	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Explicit	N/A	Technology adoption (1), power balance (1), SC integration (1)	N/A	Company size (1), position in SC (1), perishable product characteristics (1), market characteristics (1), distance to market (1)	N/A	Information sharing (2)	N/A
Implicit	N/A	N/A	N/A	Information quality (2)	Trust (1), commitment (1)	Information sharing (1)	N/A

Table 4

Positioning the information sharing construct

Table 5 summarises the authors who support the positioning of information sharing among other constructs in the IS-PPSC literature. It can be observed that the vast majority of articles address information sharing as either a primary or secondary dimension. As a primary dimension, information sharing reduces inventory cost, decreases spoilage, and increases availability and service level (Ketzenberg *et al*., 2015). The relationship between information sharing and PPSC performance is mediated by the quality of the communication between PPSC actors (Peng *et al.*, 2014). The benefits of information sharing are highest when demand variability is high, product shelf lives are short, and the cost of the product is high (Ferguson and Ketzenberg, 2006).

As a primary dimension, information sharing is driven by other constructs including openness and collaboration as its antecedents. Openness between PPSC actors can improve trust and therefore information sharing; increasing the value of the PPSC (Kottila, 2009). Low levels of collaboration hinder the flow of information; affecting product flow, product availability, and competitive advantage (Kottila, 2009). This argument suggests that information sharing can only exist once trust and collaboration are established (Kähkönen and Tenkanen, 2010; Kottila, 2009), which is inconsistent with another stream of research that positions information sharing as an antecedent of collaboration, trust, innovation, and transparency, all of which have been shown to influence PPSC operations and customer satisfaction (Aggarwal and Srivastava, 2016; Krishnakumar *et al*., 2009; Mylan *et al.*, 2015; Paterson *et al*., 2008; Trienekens *et al.*, 2012).

As a secondary dimension, information sharing cannot be separated from other primary dimensions such as supply chain relationships, demand management, and technology adoption. Relationships in the PPSC are characterised by intense information sharing, which facilitates supply chain actors to manage their functions to meet market-specific requirements (Clements *et al.*, 2008). Consistent information sharing and data handling procedures are key to enabling the alignment of demand and supply in the PPSC (Taylor and Fearne, 2009; Taylor, 2006). Adopting information sharing technology such as product movement analysis (PMA) allows the sharing of point of sales (POS) data leading to better forecasts of final demand (Mohtadi and Kinsey, 2005). In addition, the use of standardised information systems, mobile technologies, or radio frequency identification (RFID), all incur high joint investment costs. However, these technologies enable a continuous flow of information and enhanced supply chain traceability, leading

to reduced risk of product safety problems in the PPSC (Engelseth, 2013; Klein *et al.*, 2014; Dong *et al.*, 2015; Chircu *et al.*, 2014).

Our review finds no literature which posits information sharing as a moderating or mediating construct. However, information sharing as a consequence of other constructs does appear. Hill and Scudder (2002) position information sharing as a consequence of technology adoption. They find that although the use of electronic data interchange (EDI) does not significantly impact on the degree of coordination between firms and their customers, EDI users have a higher degree of coordination with their suppliers. They measure coordination in terms of the active role of firms in an efficient consumer response (ECR) programme in which information sharing is a key element (see Corsten and Kumar (2005) for ECR measures). Hill and Scudder (2002) further suggest that EDI is used as a tool for improving efficiency rather than for facilitating supply chain integration.

Conversely, Kähkönen and Tenkanen (2010) examine the relationship between market power and the willingness to share information. They find that supply chain actors with greater market power (close to the end customer) often have control over market intelligence information, and therefore are not willing to share information upstream in the supply chain. The degree of supply chain vertical integration also affects the choice of information sharing technologies ranging from barcoding, enterprise resource planning (ERP), and EDI (Bhakoo *et al*., 2015). To ensure flexibility in sharing information, vertically disintegrated supply chains have a broader portfolio of technologies compared to vertically integrated supply chains which focus on standardised technologies to monitor and share performance information across the supply chain (Bhakoo *et al*., 2015).

Table 5. Respective authors of IS-PPSC

IS-PPSC	Number of articles	Authors
Information sharing as an explicit antecedent	5	Aggarwal and Srivastava (2016); Krishnakumar *et al.* (2009); Mylan *et al.* (2015); Paterson *et al.* (2008); Trienekens *et al.* (2012)
Information sharing as an implicit antecedent	N/A	N/A
Information sharing as a primary dimension	22	Beulens *et al.* (2005); Bevilacqua *et al.* (2009); Eksoz *et al.* (2014); Ferguson and Ketzenberg (2006); Henry and Wernz (2015); Jraisat *et al.* (2013); Kaipia *et al.* (2013); Kassahun *et al.* (2014); Ketzenberg and Ferguson (2008); Ketzenberg *et al.* (2015); Kottila (2009); Nakandala *et al.* (2017); Peng *et al.* (2012); Peng *et al.* (2014); Ringsberg (2015); Schwarz and Zhao (2011); Shi *et al.* (2010); Solér *et al.* (2010); Trienekens and Wognum (2013); Yan *et al.* (2016); Zhang and Bhatt (2014); Zhong *et al.* (2015)
Information sharing as a secondary dimension	18	Alftan *et al.* (2015); Anastasiadis and Poole (2015); Chircu *et al.* (2014); Clements *et al.* (2008); Dong *et al.* (2015); Engelseth (2013); Klein *et al.* (2014); LeBlanc *et al.* (2015); Liljestrand (2017); Mena *et al.* (2011); Mohtadi and Kinsey (2005); Muangchoo and Kritchanchai (2015); Papert *et al.* (2016); Scholten and Schilder (2015); Smith and Lawrence (2014); Taylor (2006); Taylor and Fearne (2009); Van Veen-Dirks and Verdaasdonk (2009)
Information sharing as an explicit moderating dimension	N/A	N/A
Information sharing as an implicit moderating dimension	N/A	N/A
Information sharing as an explicit mediating dimension	N/A	N/A
Information sharing as an implicit mediating dimension	N/A	N/A
Information sharing as an explicit consequence	2	Hill and Scudder (2002); Kähkönen and Tenkanen (2010)
Information sharing as an implicit consequence	1	Bhakoo *et al.* (2015)

The role of perishable product related variables

Although a considerable amount of literature explicitly and implicitly addresses perishable product performance (see Table 4), contrary to our expectation, only six out of 48 articles explicitly address the importance of the characteristics of perishable products in the PPSC. Additionally, those articles present divergent findings on how perishable product characteristics shape the relationship between information sharing and PPSC performance.

Hill and Scudder (2002), for example, find that product characteristics such as seasonality and perishability do not predict whether a company is more likely to use EDI and hence have enhanced information sharing with its suppliers. In contrast, Clements *et al.* (2008) argue that the vulnerable nature of the products (i.e. being perishable and seasonal) leads to frequent information sharing, supporting tight delivery schedules and PPSC integration, maintaining product quality. Other perishable product characteristics

such as sensitivity to temperature also need to be considered when designing an information sharing system to enhance supply chain visibility and therefore product quality (Papert *et al*., 2016).

Ferguson and Ketzenberg (2006), Ketzenberg and Ferguson (2008), and Ketzenberg *et al.* (2015) are among the few authors that explicitly examine the role of perishable product characteristics in the IS-PPSC literature. According to Ferguson and Ketzenberg (2006), the shelf life and demand variability of perishable products moderates the relationship between information sharing and PPSC performance in terms of product freshness. Optimal benefits from sharing information are gained when product shelf lives are short, and demand variability is high (Ferguson and Ketzenberg, 2006; Ketzenberg and Ferguson, 2008). However, Ketzenberg *et al*. (2015) find that the value of information sharing in the PPSC follows a "diminishing return". For highly perishable products with very short shelf lives, of a day or less, there is little uncertainty as to when the product will perish; thus sharing time-temperature information confers little value to the supply chain (Ketzenberg *et al*., 2015). The value of information increases with shelf life to an intermediate level of perishability (about a seven-day shelf life); the value then drops as the level of perishability decreases so that sharing time-temperature information becomes irrelevant when the product is not perishable (Ketzenberg *et al*., 2015).

In summary, while all the literature reviewed agrees that information sharing affects PPSC performance, the relationship between information sharing and PPSC performance remains unclear, and there is inconsistency in the positioning of information sharing relative to the wide range of constructs and variables studied. Not all of the studies included here consider information sharing as a primary dimension; this makes it difficult to determine whether or not information sharing has a direct impact on PPSC performance. Moreover, although this study has strictly limited the scope of review to the PPSC context, very few studies explicitly study perishability derived variables and performance; indicating that the role of product perishability in shaping the relationship between information sharing and PPSC performance has largely been ignored. We argue that a thorough categorisation of constructs and classification of the role of perishable product characteristics in the IS-PPSC is required to refine the relationship between information sharing and PPSC performance. To address this, in the following section, we re-examine our findings in the context of our initial framework of IS-PPSC built on the TCE, OIPT, and CT theoretical perspectives. The departure of our findings from the initial framework then leads to the development of propositions for further research on IS-PPSC.

A Refined Framework of IS-PPSC (step 6)

Drawing on the constructs of TCE, OIPT, and CT, we classify the constructs and variables of IS-PPSC identified in Table 4 according to the uncertainty and information sharing capabilities which affect the relationship between information sharing and PPSC performance (see Table 6). This classification is based on our initial theoretical framework presented in Figure 1. From the perspectives of TCE and OIPT, relationship uncertainty includes relationship/asset-specific investments and supply chain (SC) interdependence (Yigitbasioglu, 2010; Kim *et al.,* 2005; Premkumar *et al.*, 2005). In this SLR, we classify investments in information sharing systems as relationship/asset-specific investments. Yigitbasioglu (2010) measures supply chain (SC) interdependence in terms of the degree of process customisation required to operate in the supply chain and the potential switching costs associated with replacing supply chain partners. Whereas, Kim *et al.* (2005) measure interdependence in terms of the degree of collaborative or integrative work which occurs between supply chain actors. Accordingly, we classify all constructs and variables related to supply chain collaboration and integration as SC interdependence. This classification is also partly based on dependency factors suggested by Cool and Henderson (1998).

In line with Wong *et al.* (2011), we measure environmental uncertainty in terms of external conditions and internal operations. Accordingly, we classify perishable product characteristics as uncertainty in internal operations. We extend Premkumar *et al.*'s (2005) classification of information sharing capabilities to include all variables related to technology and information management. Finally, following Beamon (1999) and Yigitbasioglu (2010), we classify supply chain performance constructs and variables as output, resource, and flexibility measures. We then reproduce Table 4, replacing the identified constructs and variables with these higher level themes (see Table 7).

This means of classifying constructs and variables allows us to characterise the patterns and relationships which exist between the identified higher level themes. Ultimately, it allows us to construct a refined theoretical framework which formalises the relationship between information sharing, the identified central themes, and PPSC performance (see Figure 3). Solid arrows represent the initial theoretical framework based on TCE, OIPT, and CT, whereas the dashed arrows represent the propositions for future research and therefore the refined framework of IS-PPSC. The IS-PPSC literature to date suggests that the relationship mechanisms between information sharing and PPSC performance are much more complicated than the theory had originally

suggested. We, therefore, develop a set of propositions for future research to confirm our findings.

Table 6. Classification of IS-PPSC constructs and variables

Central themes	Categories	Constructs and variables
Relationship uncertainty	Relationship/asset-specific investments	Investment on information sharing system
	SC inter-dependence	SC collaboration, SC integration, trust, openness, transparency, commitment, power relations, SC relationship, governance structure, coordination structure, network structure, position in SC, distance to market
Environmental uncertainty	External conditions	Regulation, customer satisfaction, market characteristics, sales
	Internal operations	SC practices, demand management, inventory management, order management, procurement management, quality management, transportation management, forecasting, yield, resource allocation, risk management, costs and benefits of information sharing, business strategy, business process, innovation, problem identification, staff involvement, performance incentives, distribution of perishables, entrepreneurial orientation, SC resilience, responsiveness, perishable product characteristics
Information sharing capabilities	Technology and information management	Technology adoption, information quality, communication quality, communication media, frequency of communication, information access, information types, information standard, information needs, information use, visibility, velocity of information, flexibility of information management, SC database
PPSC performance	Output performance	Profitability, revenue, sales, delivery, customer satisfaction, service level, yield, stockout, market share, environmental cost, sustainability, product safety, product quality, product availability, shelf life, product freshness, waste, spoilage
	Resource performance	SC efficiency, inventory cost, transaction cost, resource allocation, labour hired, administration cost
	Flexibility performance	Competitiveness, problem resolution, ability to forecast demand, SC resilience, responsiveness

Table 7. Positioning of IS-PPSC constructs and variables with higher level themes

Explicitly or implicitly mentioned in the literature?	Antecedents	Primary dimensions	Secondary dimensions	Moderating dimensions	Mediating dimensions	Consequences/types of the PPSC performance
Explicit	Information sharing	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** Internal operations	N/A	**Information sharing capabilities:** technology and information management	N/A	Output, resource
Implicit	N/A	N/A	N/A	N/A	N/A	N/A
Explicit	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** external conditions, internal operations **Information sharing capabilities:** technology and information management	Information sharing	N/A	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	**Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	Output, resource, flexibility
Implicit	**Information sharing capabilities:** technology and information management	N/A	N/A	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	N/A	Output, resource
Explicit	**Relationship uncertainty:** Relationship/asset-specific investments, SC inter-dependence **Information sharing capabilities:** technology and information management	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	Information sharing	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations	**Information sharing capabilities:** technology and information management	Output, resource, flexibility

Table 7 (continued)

Explicitly or implicitly mentioned in the literature?	Antecedents	Primary dimensions	Secondary dimensions	Moderating dimensions	Mediating dimensions	Consequences/types of the PPSC performance
Implicit	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	N/A	N/A	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** internal operations **Information sharing capabilities:** technology and information management	N/A	Output, resource, flexibility
Explicit	N/A	N/A	N/A	N/A	N/A	N/A
Implicit	N/A	N/A	N/A	N/A	N/A	N/A
Explicit	N/A	N/A	N/A	N/A	N/A	N/A
Implicit	N/A	N/A	N/A	N/A	N/A	N/A
Explicit	N/A	**Relationship uncertainty:** SC inter-dependence **Information sharing capabilities:** technology and information management	N/A	**Relationship uncertainty:** SC inter-dependence **Environmental uncertainty:** external conditions, internal operations	N/A	Information sharing
Implicit	N/A	N/A	N/A	**Information sharing capabilities:** technology and information management	**Relationship uncertainty:** SC inter-dependence	Information sharing

Table 7

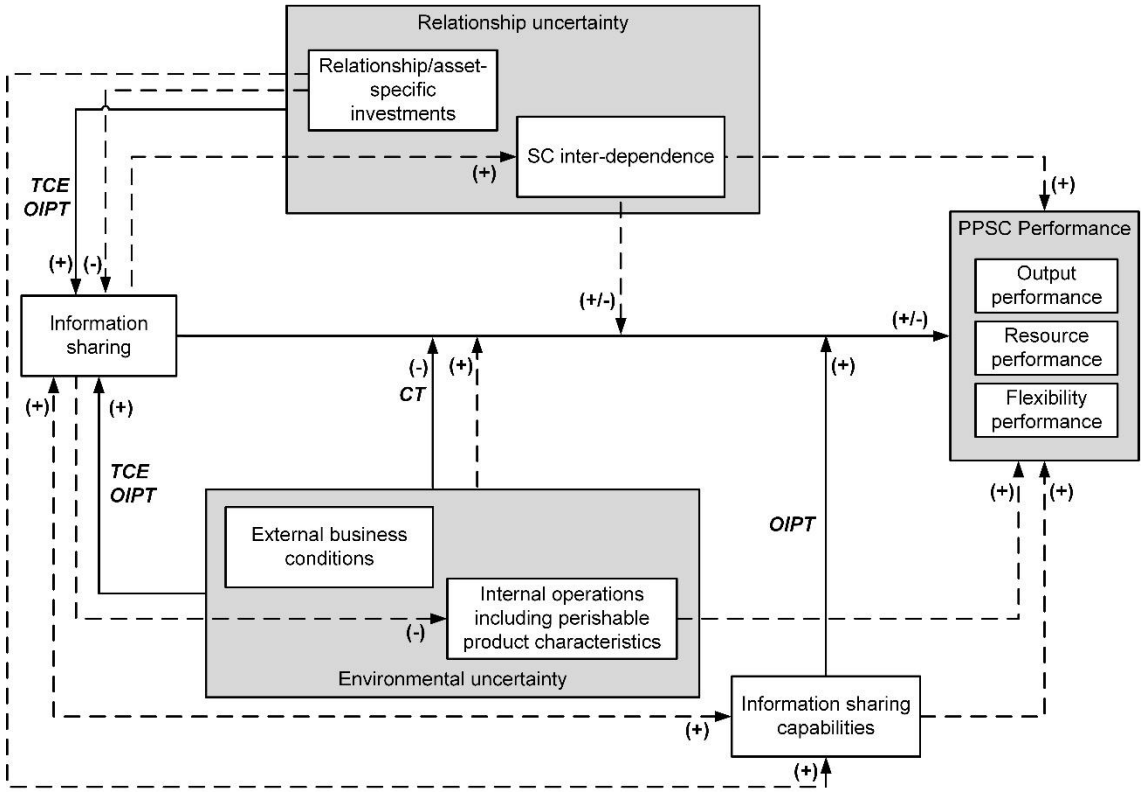

Figure 3. Refined framework of IS-PPSC

Information sharing, relationship uncertainty, and PPSC performance

Our initial theoretical framework positions relationship uncertainty as an antecedent that positively affects information sharing and therefore supply chain performance. From TCE and OIPT perspectives, relationship uncertainty reflects the degree of relationship/asset-specific investment and interdependence amongst supply chain actors (Yigitbasioglu, 2010; Kim *et al.,* 2005; Premkumar *et al.*, 2005). The greater the relationship/asset-specific investment, the greater the need to share information (Premkumar *et al.*, 2005). Investment into specific assets that do not have value outside the relationship between the supply chain actors incurs a risk that the asset is "locked up" in that relationship; "forcing" supply chain actors to share information to maintain a tight long-term relationship (Premkumar *et al.*, 2005; Yigitbasioglu, 2010).

While we find a paucity of studies addressing relationship/asset-specific investment in the IS-PPSC, those studies we do identify contradict this inference. It is agreed that sharing product related information is essential in the PPSC and is usually facilitated by traceability systems. In cases where traceability compliance is not mandatory by law, Klein *et al.* (2014) find that high investment cost is a barrier to the adoption of traceability

systems. The main cost of such investment is usually borne by the producers, driven by buyers' expectation of safe products and technology infrastructure. This leaves producers in a "locked up" relationship with no real belief in the benefits of the traceability systems they have invested in; hindering information sharing due to the poor use of the systems and therefore affecting product safety in the PPSC (Klein *et al.*, 2014).

Our SLR also finds a negative relationship between perceived relationship/asset-specific investment and IS-PPSC outside the "locked up" environment. Engelseth (2013) argues that to achieve total mandatory traceability and therefore information sharing across the PPSC, investment in joint IT systems is required to integrate inter-organisational supply chain networks. While a traceability system is vital for delivering product safety and quality, in practice, supply chain actors are reluctant to share information using such an expensive system. Instead, manual solutions although prone to incidents are preferred, reducing investment risk (Engelseth, 2013).

While more empirical investigation is still required, these arguments imply that high relationship/asset-specific investment does not necessarily lead PPSC actors to share information. Instead, it can negatively affect willingness to share information when it is perceived to be an expensive solution with minimal benefit to for the PPSC actors. This leads to our first proposition (P1):

P1. In the context of the PPSC, the higher the perceived costs of relationship/asset-specific investments for sharing information, the lower the willingness to share information and therefore the PPSC performance.

Relationship uncertainty also reflects the degree of interdependence amongst supply chain actors. Both TCE and OIPT posit that the degree of interdependence between buyers and suppliers positively affects the intensity of information sharing in the PPSC (Yigitbasioglu, 2010; Kim *et al.*, 2005). While some IS-PPSC literature supports this postulation (e.g. Kottila, 2009; Jraisat *et al.*, 2013), our SLR finds that the role of SC interdependence in the relationship between information sharing and PPSC performance is inconsistent; and further research is required.

In the PPSC context, SC interdependence can have an interactive relationship with information sharing. For example, Kottila (2009) suggests that low levels of collaboration hinder the flow of information; affecting product flow, product availability, and competitive advantage. This puts collaboration as an antecedent of information sharing. Information sharing helps PPSC actors to increase the transparency of their activities, improves trust and strengthens collaboration; thus leading to secure and sustained inter-organisational

relationships (e.g., Paterson *et al*., 2008; Aggarwal and Srivastava, 2016) and improved output performance such as product safety, quality, and availability (Clements *et al.,* 2008). Contrary to TCE and OIPT, these arguments imply that information sharing is an antecedent of collaboration and therefore SC interdependence, which in turn positively affects PPSC performance. Accordingly, we formulate P2:

P2. In the context of the PPSC, increasing the intensity of information sharing increases SC interdependence and therefore improves PPSC performance.

Our SLR further finds that the strength of the relationship between information sharing and PPSC performance is dependent on the nature of SC interdependence. This moderation effect is particularly relevant when the relationship between supply chain actors is not mutually beneficial or when there is a power imbalance. For example, retailers with significant market power and a large supplier base are more willing to share sensitive market and inventory information than those with a smaller number of suppliers, and are hence logistically more efficient (Mohtadi and Kinsey, 2005). These powerful retailers facilitate open information sharing and are less concerned with the potential for opportunistic behaviour from suppliers. In contrast, Kähkönen and Tenkanen (2010) argue that such retailers use their market position and power to control market information and their suppliers and are, therefore, less willing to share information.

The moderating effect of SC interdependence also manifests itself when the PPSC is not perfectly integrated, and the benefits of information sharing are not shared equally between the PPSC actors. Ferguson and Ketzenberg (2006) highlight that while information sharing may help the retailer to decrease its outdate level, the outdate level of the suppliers will consequently increase. With this substantiation, P3 follows:

P3. In the context of the PPSC, the relationship between information sharing and PPSC performance is moderated by SC interdependence.

Information sharing, environmental uncertainty, and PPSC performance

TCE, OIPT, and CT have different positions on the role of environmental uncertainty in IS-PPSC. TCE and OIPT both agree that environmental uncertainty is an antecedent that positively affects information sharing and therefore PPSC performance (Yigitbasioglu, 2010; Kim *et al.,* 2005; Premkumar *et al.*, 2005). As an external condition, government regulation is one of the main factors positively affecting the intensity of information sharing (Yigitbasioglu, 2010); whereas product complexity, product criticality, demand uncertainty, supply uncertainty, and technology uncertainty represent internal

operations positively affecting the need to share information across the supply chain (Premkumar *et al.*, 2005).

Our SLR also finds an interactive relationship between environmental uncertainty and information sharing. Regulation and product perishability represent uncertainty in external conditions and internal operations respectively which motivates supply chain actors to establish information sharing systems (Kassahun *et al*., 2014). In return, information sharing enables the tracking and tracing of perishable products, decreasing spoilage, reducing product waste and improving product freshness (Papert *et al.,* 2016; Klein *et al.*, 2014; Ketzenberg *et al*., 2015; Kaipia *et al*., 2013; Ketzenberg and Ferguson, 2008); therefore reducing uncertainty in internal operations. P4 ensues:

P4. In the context of the PPSC, increasing the intensity of information sharing lowers uncertainty in internal operations and therefore improves PPSC performance.

Unlike TCE and OIPT, CT posits that environmental uncertainty moderates the relationship between information sharing and PPSC performance (Wong *et al.*, 2011). Using CT, Wong *et al.* (2011) find that information sharing leads to better performance when supply chain actors operate under less uncertain external conditions while at the same time offering more complex but less perishable products to customers. This argument is in line with Ketzenberg *et al.* (2015) suggesting that the value of information sharing increases with respect to decreasing demand uncertainty. Contrary to this, in the PPSC context, Clements *et al.* (2008) imply that external conditions such as the changing seasons and unpredictable weather increase environmental uncertainty; strengthening the positive relationship between information sharing and PPSC performance. Ferguson and Ketzenberg (2006) also suggest that the benefits of information sharing are highest when demand variability is high, product shelf lives are short, and the product cost is high; in other words under highly uncertain internal operations. In addition, Ketzenberg and Ferguson (2008) propose that the requirement of the PPSC to deliver fresh products imparts a higher value to information sharing; suggesting that product perishability strengthens the positive relationship between information sharing and PPSC performance.

Given the contradictory arguments between CT and the reviewed IS-PPSC literature, empirical evidence is currently lacking. The majority of the studies from which our SLR is derived are classified by Pilbeam *et al*. (2012) as empirical research. However, Ferguson and Ketzenberg (2006), Ketzenberg and Ferguson (2008), and Ketzenberg *et al*. (2015) all build their arguments using mathematical models and simulation which are

classified by Pilbeam *et al.* (2012) as analytical research and as such are subject to a significant number of assumptions. Empirical research, despite the uncontrolled variables in many settings, has the potential to confirm or refute these findings, contributing to a refined understanding of the role of environmental uncertainty including product perishability in shaping the relationship between information sharing and PPSC performance.

Interestingly, both Wong *et al.* (2011) using CT and the reviewed IS-PPSC literature, based largely on empirical studies, define and measure product perishability only considering product shelf life. In fact, perishable products are associated with a distinctive set of characteristics. Some perishable products are more vulnerable than others, making them more susceptible to contamination by disease and damage by unpredictable weather. This makes it difficult to guarantee quality standards and product availability (Clements *et al.*, 2008). Also, special storage conditions, such as a cold chain, are often required to slow the rate of product decay (Van Donselaar *et al*., 2006). Extensive information sharing is therefore critical for controlling and monitoring of product safety and quality across the supply chain (Shi *et al*., 2010; Salin, 1998).

While some of these characteristics are discussed implicitly in the IS-PPSC literature, we find no article which explicitly and specifically addresses the role of perishable product characteristics in shaping the relationship between information sharing and PPSC performance. We argue that the more vulnerable the product, the more beneficial is information sharing to the product supply chain. Similarly, consistent with Premkumar *et al.* (2005), we argue the more critical a product is to human life, the more beneficial is inter-organisational information sharing. P5 and P6 are proposed:

P5. In the context of the PPSC, the higher the uncertainty in external conditions, the stronger the positive relationship between information sharing and PPSC performance.

P6. In the context of the PPSC, the higher the uncertainty in internal operations, the stronger the positive relationship between information sharing and PPSC performance.

P6a. In the context of the PPSC, the shorter the shelf life of products in the PPSC (the more perishable), the stronger the positive relationship between information sharing and PPSC performance.

P6b. In the context of the PPSC, the more vulnerable the product (the more susceptible to contamination and/or damage), the stronger the positive relationship between information sharing and PPSC performance.

P6c. In the context of the PPSC, the more critical the product for human health, the stronger the positive relationship between information sharing and PPSC performance.

Information sharing, information sharing capabilities, and PPSC performance

Finally, OIPT posits that the degree of fit between information sharing needs and information sharing capabilities leads to improved supply chain performance (Kim *et al.,* 2005; Premkumar *et al.*, 2005). Consistent with this postulation, the majority of the IS-PPSC literature implicitly suggests that, to be effective, information sharing needs to be supported by quality information and relevant adoption of information sharing technology (e.g. Bevilacqua *et al*., 2009; Kassahun *et al.*, 2014; Shi *et al*., 2010; Yan *et al*., 2016; Zhang and Bhatt, 2014); therefore they are implicitly positioned as moderating dimensions in the IS-PPSC (see Table 4).

Information quality refers to accuracy, reliability, relevance, adequacy, ease of access and timeliness of the information shared across the PPSC (Bensaou, 1995); whereas information sharing technology can range from radio-frequency identification (RFID) to Internet-based traceability systems (e.g. Shi *et al.*, 2010). For example, the appropriate use of quality information strengthens the benefits of information sharing such as reduced waste, increased product availability (e.g. Kaipia *et al.*, 2013), and even improved profitability (e.g. Schwarz and Zhao, 2011). Similarly, visibility of product flow and real-time monitoring of cold chain distribution should be supported by appropriate information sharing technology such as RFID, sensor, and wireless communication technologies to ensure product quality during the distribution (e.g. Shi *et al.*, 2010).

Inconsistent with OIPT, our SLR finds that information sharing capabilities can also be a mediating construct and at the same time an antecedent in the IS-PPSC, forming an interactive relationship. For example, Peng (2014) suggests that the willingness to share information and information sharing behaviour (i.e. the frequency of sharing information and multifunctional staff involved) positively affect information quality, which in turn positively affects information sharing benefits such as cost reduction, problem resolution, quality control and delivery, and efficiency of the PPSC. On the other hand, the willingness to share information is dependent on the ease of access of the shared platform such as traceability system or information centre (e.g. Zhong *et al*., 2015; Trienekens and Wognum, 2013), which requires the willingness of PPSC actors to invest in relationship/asset specific information sharing technologies (e.g. Klein *et al.*, 2014; Engelseth, 2013). This leads to our final propositions for future research P7-P9:

P7. In the context of the PPSC, the stronger the willingness to share information, the higher the information sharing capabilities and therefore PPSC performance.

P8. In the context of the PPSC, increasing information sharing capabilities leads to increased willingness to share information and therefore PPSC performance.

P9. In the context of the PPSC, increasing the relationship/asset-specific investment leads to increased information sharing capabilities and therefore PPSC performance.

Conclusions and implications

Our SLR suggests that the relationship between information sharing and PPSC performance remains unclear and that there is inconsistency in the positioning of information sharing amongst the other constructs and variables identified in the IS-PPSC literature. This inconsistency reflects different ways of understanding the phenomenon of IS-PPSC and its relationship with PPSC performance. In addition, while we have strictly limited the scope of review to the PPSC context, the role of perishable product characteristics in shaping the relationship between information sharing and PPSC performance has been largely ignored by studies to date.

This study provides a novel contribution by addressing the research call for more investigation into the relationship between product perishability, information sharing, and supply chain performance for industries with specific logistical requirements (Wong *et al*., 2011). By focusing on the phenomenon of IS-PPSC for both edible and non-edible perishable products, this study extends the work of Shukla and Jhakharia (2013) who conducted a literature review on fresh produce supply chain management.

While applying strict criteria for the SLR, we find that our carefully-designed initial theoretical framework, drawn upon TCE, OIPT, and CT does not entirely hold in the context of PPSC. This provides a legitimacy to support the classical notion of “one size doesn’t fit all”, where the relationship mechanisms between information sharing and PPSC performance are much more complicated than TCE, OIPT, and CT had suggested from the general supply chain context. We, therefore, contribute a refined framework of IS-PPSC, based on eight propositions for future research which will potentially confirm, disprove, or add to TCE, OIPT, and CT in the particular context of PPSC. The propositions can also serve as practical guidelines for how to use information sharing to improve the performance of the PPSC. The use of multiple theories in this study helps to fill the gap in the IS-PPSC literature, where there is a paucity of studies which take a theoretical perspective and supports Kembro *et al.*’s (2014) call for the use of multiple

theoretical perspectives to comprehensively understand the phenomenon of information sharing in supply chains.

This study also extends the work of Kembro and Näslund (2014) who conducted a SLR to examine the empirical evidence of the benefits of information sharing in general supply chains. Our novel contribution is in the specific context of the PPSC and the positioning of information sharing amongst other important constructs that affect PPSC performance. This study further serves as a proof of the applicability of the proposed new paradigm for SLR in supply chain management, which was conceptually developed by Durach *et al.* (2017).

Our work has several limitations. Firstly, to incorporate multiple theoretical perspectives, our initial theoretical framework was not developed purely upon PPSC literature. This might reduce the transferability of the initial framework to the PPSC context. Secondly, this study is based purely on a literature review, which is used to unravel the relationship between information sharing and PPSC performance. Future work should use a large scale survey to test the propositions proposed in this study and hence the relationships between constructs and variables. Thirdly, our discussion is limited to information sharing studies in the perishable product context. The generalisation and adaptation of the findings to other supply chain contexts should be done with care. Finally, even though a SLR provides rigorous processes, the mechanistic way in which data is collected from online databases limits the results to articles retrieved using pre-determined keywords. It is possible, therefore, that relevant articles are not captured by the search engines. Carefully designed keywords and additional cross-referencing has reduced the impact of this limitation but will not resolve it completely.

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