Information Standards in Retailing? A Review and Future Outlook

Abstract

Purpose
As a result of the ongoing digitalisation of retailing, we are now seeing increasing interest from many actors participating in the retail value chain to redefine the information standards and protocols through which manufacturers, wholesalers, and retailers collaborate and share data.

Design Methodology/Approach
The purpose of this conceptual study is to understand the role of information standards in the retail value chain and their implications across the retail sector, both now and into the future. First, we review existing literature on information standards across disciplines and sectors, then present a set of propositions about how '*global'* and '*local'* information standards, i.e. elaborate systems of standards, may influence actors participating in the retail value chain.

Findings
We illuminate the strategic implications of information standards on consolidation, competition, and collaboration in the retail value chain, including their potential benefits and drawbacks.

Practical implications
We argue that retailers face a risk that rather than a '*global'* standard for information exchange emerging, adopted by a majority of leading retailers worldwide, and spearheaded by global standard-setting bodiess, as well as consultants and technology providers, several '*local'* information standards may emerge which only ensure the interoperability of particular transaction partners. As such, managers of organisations operating across the retail value chain need to be aware of how both '*global'* or '*local'* information standards may represent a two-bladed sword.

Originality and Value
This conceptual study is one of the first studies to consider the strategic, sector-level implications of information standards in the specific context of the retail sector.

Keywords: Information standards, transaction cost economics, knowledge-based view, technology, e-commerce

1. Introduction

Retail has become increasingly data-driven during the past few decades (Savastano *et al.* 2019), as new digital retail channels (Hänninen *et al.* 2019) and technologies (Grewal *et al.* 2017), now challenge incumbent retailers worldwide. This increased digitalisation of retail has enabled retailers to aggregate data from across the retail value chain to better and more

efficiently understand customer needs, wants and expectations (Evans and Kitchin, 2018). For example, the spur of big data and improved data analytics capabilities have enabled retailers to shift from aggregate to an individual level of analysis of end-customer behaviour (e.g. Agarwal and Dhar, 2014), with retailers now able to more accurately track end-customers and link their transactions over time (Bradlow *et al.* 2017).

Information standards are an important enabler of this trend (Dawson, 1994). In general, information standards set the norms for inter-organisational collaboration and information exchange as by definition they are "*the technical specifications that define the rules of interaction between the different complementary technologies"* (Ranganathan *et al.* , 2018, p. 3196). Accordingly, through advances in information technology, any exchange or transaction can now be standardised to some degree to ensure interoperability between heterogeneous organisations (e.g. Bala and Venkatesh, 2007). In retail, information standards have historically played a role in shaping the evolution of the sector (e.g. Viyasarathy & Tyler, 1997). For example, the first barcode standards and standards for exchanging electronic documents were introduced already in the 1970s. These combined with the standardization of many other activities in the retail value chain, such as packaging or handling systems, have been instrumental in enabling efficiency gains for retailers over the past few decades. Information standards have thus transformed the retail sector and enabled the adoption of better supply-chain integration mechanisms (e.g. Hagberg *et al.* 2016). In particular, the standardisation of information sharing norms and protocols, have historically enabled retailers to more effectively coordinate activities between manufacturers, wholesalers, and retailers, for goods to be "*produced and distributed in the right quantities to the right locations at the right time and for the right price*" (Brown *et al.*, 2005, p. 101-102). For example, in the UK information standards

have delivered direct financial benefits to retailers using EDI (electronic data interchange) to share data across their value chain, estimated at over £650 million annually (GS1 UK, 2010).

Yet, while information standards have enabled the retail value chain to become more integrated (Gallino and Moreno, 2014) and the competitive advantage of retailers to shift from delivering local, personal service, to efficient sourcing and distribution (Ellis and Kelley, 1992), we are only at the beginning of more large-scale standards developments in the sector (Aastrup et al. 2007). Today, customers expect increasingly personalised customer experiences (e.g. Savastano *et al.* 2019), and to receive more detailed product information, for example, about product quality (e.g. Kopalle *et al.* 2017), country of origin (e.g. Berry *et al.* 2015), and nutritional content (e.g. Saarijärvi *et al.* 2019). Accordingly, there is a need for retailers to develop more advanced information representation and transmission protocols, to be able to share more accurate and detailed product information at the individual rather than aggregate product level, for example, to ensure product availability across any channel (Piotrowicz and Cuthbertson, 2014). These more elaborate systems of standards will likely have similar repercussions as the early standards had on the integration and coordination of the retail value chain.

Thereby, the ongoing digitalisation of retail has created a need for actors across the retail value-chain to develop and adopt more elaborate systems of standards to exchange supply and demand-side data (e.g. Oh *et al.* 2019), especially as the convergence of the online and offline retail channels has created new challenges regarding the availability and aggregation of product information (Banerjee, 2014). To meet these challenges and sector-level transformations, global standard-setting organisations (e.g. *GS1, ISO*), in addition to consultants and technology providers, are now promoting elaborate systems of standards, i.e. '*global'* information

standards, for presenting, exchanging and storing information to facilitate the interoperability and information exchange between actors across the retail value chain. These '*global'* standards seek to lower transaction costs and facilitate knowledge sharing across the retail value chain. However, simultaneously many retailers are developing their own *'local'* information standards to regulate and govern their internal value chains and transactions between co-specialised transaction partners. Compared to a universal '*global'* standard that would apply to all actors participating in the retail value chain, the more exclusive '*local'* standard only covers the relationships between a subset of specific and unique actors in the retail value chain. For example, while *Amazon* requires its third-party sellers on the *Amazon Marketplace* to adopt the *GS1 GTIN* standard to standardise product information (a '*global'* standard), it is simultaneously developing its own '*local'* standard - *Amazon Transparency* - to help brands and customers identify the authenticity of the merchandise sold through *Amazon* (Amazon.com, 2019). This poses a significant sector-level dilemma, as it is unclear whether a single '*global'* information standard will emerge shortly to ensure interoperability across the retail value chain or a host of '*local'* information standards that regulate information sharing only between particular transaction partners. Also, the dual-role of *Amazon* and *Alibaba* as technology providers, and '*local'* standards developers may pose a risk. Regardless of which alternative emerges, actors in the retail value chain need to understand both the potential benefits and drawbacks associated with the standardisation of information exchange as decisions made now will likely shape the competitive dynamics of the retail sector for decades to come.

In this paper, we aim to understand the role of information standards in the retail sector and how the standards development may play out across the sector in the future. Through a review of recent research on information standards, we, therefore, develop hypotheses about the

potential of information standards to continue shaping the overall structure and power relations across the retail sector. While standards such as barcodes (e.g. Renko and Druzijanic, 2014; Reardon *et al.* 1996), EAN (e.g. ter Braak and Deleersnyder, 2018; Daunfeldt and Rudholm, 2014), EDI (e.g. Nikolaeva, 2006; Levy and Grewal, 2000), POS (e.g. Fiorito et al. 2010; Achabal and McIntyre, 1987) and RFID (e.g. Grewal *et al.* 2011; Müller-Seitz *et al.* 2009) have received large attention from scholars, our study is the first to consider the strategic, sector-level implications of information standards, in the retail context (see Table 1 for a comparison of some of the main standards currently in use across the retail sector).

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Understanding these issues is important, as although standards, such as the barcode, have had an important role in enabling the universal identification of individual goods and services (Kjellberg et al. 2019), with significant implications, for example, on global trade (Watson, 2011), and business efficiency (Beck et al. 2005), in today's data-driven economy future information standards and standards developments will continue to have significant implications on how retailers can use and exploit their now vast data resources, such as customer data, for example, in new business creation. This new data-driven business environment necessitates a renewed focus on standards in retail literature, yet missing in scope and focus. At the same time, these topics are important to understand as for individual actors in the retail value chain, adoption of more elaborate systems of standards may represent a strategic risk. Thus, our goal is not to focus only on the benefits of information standards, but also look at the potential downsides of '*global'* and '*local'* information standards for

organisations occupying different positions of the retail value chain. A review of extant literature shows that the costs of implementing information standards, and the benefits of using information standards may be distributed asymmetrically across organisations. The high perceived strategic risk may, in turn, lead to incomplete implementation of information standards (Dalmolen *et al.*, 2015) and hesitation to participate in the development and extension of new information standards (Waguespack and Fleming, 2009). In other words, the *ex-post* benefits of information standards remain unrealised because of the *ex-ante* strategic risks. We seek to identify these strategic issues and questions for a stylised model of a retail value chain, consisting of (i) manufacturers, and (ii) wholesalers and retailers.

The rest of this paper is organised as follows. First, we review existing literature on information standards across disciplines and sectors and then present a set of theoretical assumptions about to guide our work specifically in the context of the retail sector. We conclude with a set of theoretical propositions about how information standards can influence actors across the retail value chain. We aim to provide general direction and a way of thinking about information standards in retailing in the hopes of stimulating new thinking and research on the topic.

2. Theoretical Background

The past decade has seen increasing interest in information standards especially in management, strategy and IT literature. Information standards define how organisations collaborate and exchange information, to realise more benefits from inter-organisational collaboration (e.g. Bala and Venkatesh, 2007). Especially as information systems have become *"ubiquitous, heterogeneous, networked and complex"* (Lyytinen and King, 2006, p. 405)

information standards ensure interoperability across value chains (e.g. Zhao and Xia 2014) and often the success of new products and services (e.g. Chakravarti and Xie, 2006).

Information standards are set guidelines for how organisations coordinate technical interoperability to reduce uncertainty and spur growth (e.g. Ranganathan *et al.* 2018). More specifically, Leiponen (2008) defines information standards, or more specifically compatibility standards, as formal or informal agreements regarding how distinct components of a specific technical system interact and interoperate. As such, for example, Wigand *et al.* (2005) argued that the use of information standards can enable better coordination in a value chain, and disintermediation when even small organisations can via standardised technologies bypass incumbent intermediaries in the market and more easily transact with other organisations. This increased coordination comes from the reduction of technical barriers and incompatibility (Kim and Mahoney, 2006). For example, information standards can enable organisations to automate, integrate and facilitate activities such as supply-chain management, collaborative forecasting, new product development and inventory management (Bala and Venkatesh, 2007).

The competitive implications of information standards are intriguing, as information standards define the infrastructure upon which information systems and applications are built-in organisations (Lyytinen and King, 2006). Thus, information standards have the potential to level the playing field between organisations in a particular sector (Wigand *et al.*, 2005). On the other hand, Uotila *et al.* (2017) argued that creators of proprietary standards, such as dominant organisations, may gain a monopoly position and competitive advantage through participating in the development of information standards, as they are often at the forefront in shaping the architecture for collaboration and compatibility in the value chain (Boh and Yellin, 2006). For example, Lyytinen and King (2006) argued that information standards can enable

organisations to seize a significant competitive advantage, while organisations not participating in standards development face the risk of losing important markets. As a result, Leiponen (2008) for example found that organisations, particularly in network technology industries, should participate in information standards development work to be able to negotiate, discuss and align positions on technical features.

Despite the positives, although organisations have a joint interest in reducing uncertainty and spurring sector growth, research suggests that organisations participating in information standards development will nevertheless aim to steer the collective towards choices that enhance their benefits and goals (Ranganathan *et al*., 2018). For example, Garud *et al.* (2002) found that information standards always have built-in tensions due to their enabling and constraining effects that are forged in the implied collaboration with competitors. Along these lines, Uotila *et al.* (2017) argued that when powerful actors lead standards development work, it may lead to a narrow search for alternatives and the selection of suboptimal standards as many consortia and alliances cannot abandon the information standards they helped initially to establish.

As a result, global standard-setting organisations play a role in ensuring that the opinions set-out by representatives, of the competing, heterogeneous groups of organisations, are taken into account in the development of information standards and that any single organisation cannot dominate the work of standards committees. For example, Zhao *et al.* (2007, p. 248) described that standard-setting organisations and consortia *"develop or approve standards based on formal agreements through communication, political negotiation, and coordination among participants"*. Also, the role of consultants, and technology providers, is important in steering actors to implement the standards, and drive participants to often consider specific standards

spearheaded by well-known and reputable standard-setting bodiess (e.g., Casadesus *et al.*, 2002). Research has considered the benefits to organisations from participating in standards development and sector-level standards committees. Ranganathan *et al.* (2018) found that when organisations operate in highly competitive product-markets they exhibit greater support for emerging new information standards than organisations which possess a broader array of complementary products. On the other hand, for start-ups, simply participating in information standards development, even without endorsing any particular standard, can be beneficial (Waguespack and Fleming, 2009).

3. Theoretical Framework

Information standards define the interoperability of transaction partners. Next, we build a theoretical framework based on (i) transaction cost economics (e.g. Coase, 1937) and the (ii) knowledge-based view of the firm (e.g. Grant, 1996), to provide a theoretical lens for understanding the impact of information standards in the specific context of the retail sector.

3.1 Transaction Cost Perspective to Information Standards

Transaction cost economics, originally pioneered by Ronald Coase in the 1930s, is concerned with the organisation of specific economic activities within and across organisations (Conner, 1991). According to Coase (1937), procuring products from the market is often associated with higher transaction costs, for example, due to the need to find suppliers, negotiate and enforce contracts, compared to organising production vertically and making the product in-house. Therefore, as each market transaction is different, ”*due to a difference in the degree to which relationship-specific assets are involved, the amount of uncertainty about the future and about*

other parties' actions, the complexity of the trading arrangement and the frequency with which the transaction occurs" (Shelanski and Klein, 1995, p. 337), organisations should carefully evaluate the total transaction costs for any given transaction. This evaluation is important as transaction cost economics asserts that "*inefficiency in the commercial invites its own demise – all the more so as international competition has become more vigorous*." (Williamson, 1993, p. 123).

The canonical question organisations face due to the presence of transaction costs is whether to buy a component that is integral to the final product from the market, or to manufacture that component in-house (Williamson, 1991a). Transaction cost economics assumes that integrating the component manufacturing into the operations of the organisation leads to increased costs associated with weak incentives (compared to strong incentives associated with price-based coordination) and added bureaucracy. Therefore, the default option should be to buy the component from the market. However, in cases where transaction costs are high, it might make sense to make rather than buy. When transactions are infrequent and uncertain in their outcomes, and when transactions require transaction partner-specific investments (so-called '*asset specificity*'), transaction costs are high, thus favouring hierarchical, more vertical modes of governance (i.e. make), rather than the use of the market (i.e. buy) (e.g. Williamson, 1991b).

Williamson, (1975) distinguished between six sources of transaction costs, three human factors (i) bounded rationality, (ii) opportunism, and (iii) atmosphere, and three transactional factors, (i) uncertainty, (ii) small numbers bargaining, and (iii) information impactedness. Accordingly, transaction costs are primarily related to the governance of transactions, where human factors such as bounded rationality and opportunism mean that decisions made by organisations are

never perfect and often opportunistic as organisations not only optimize their actions but also actively seek to exploit contracts, while transactional factors such as uncertainty and small numbers bargaining mean that organisations manage uncertainty through complex contractual terms while a large number of suppliers and buyers in the market mean that organisations tend to limit themselves to a limited pool of, more or less, familiar suppliers (e.g. Leiblein and Miller, 2003). Therefore, especially during a long contractual period, contracts become difficult and costly to enforce (e.g. Williamson, 1975).

A central part of transaction cost economics is information impactedness, which refers to a situation where one exchange partner has more information related to a particular transaction than the other (Williamson, 1975). The effect of information standards on transaction costs is therefore straightforward: reducing the information gap lowers transaction costs, and also lowers both small numbers bargaining and opportunism as information standards enable exchange partners to have a more transparent view of the market. Thus, information standards reduce exchange partners' uncertainty about transactions by increasing transparency (e.g. Dalmolen *et al.* 2015). Since information is via information standards exchanged in a standard format, it becomes possible to reduce the transaction size and thereby increase their frequency. For example, information standards can enable firms to set-up automatic information exchange with smaller partner-specific investments. All these mechanisms reduce the frictional forces associated with using the market to acquire products (Williamson, 1991b).

3.2 Knowledge-Based View Perspectives to Information Standards

The knowledge-based view (Grant, 1996) provides a complementary view of the influence of information standards on the retail value chain. According to the knowledge-based view, organisations exist as repositories of knowledge that cannot be sold and bought in the market.

Accordingly knowledge, defined as an organized combination of ideas, rules, procedures, and information (Marakas, 1999), compared to an organisation's tangible resources and capabilities, may be the critical differentiating factor from the competition, as knowledge extends its value more broadly and is not depleted in use (Wilcox King and Zeithaml, 2003).

A key characteristic of organisational capabilities is their non-substitutable and hard to imitate nature (Rugman and Verbeke, 2002). Organisations create new knowledge through the process of organisational learning, in which organisations create, retain and transfer knowledge within the organisation (e.g. Senge, 1990). Thus, the unique organisational learning process means that it is hard for any competitor to directly imitate and replicate other organisations knowledge base (e.g. McEvily and Chakravarthy, 2002). Besides, organisations continuously absorb both internal and external knowledge, combine it with pre-acquired knowledge and create new ones to further extend their knowledge base (Cohen and Levinthal, 1990). As such, knowledge is regarded as one asset through which organisations can create a sustainable competitive advantage (e.g. Argote and Ingram, 2000).

By definition, knowledge is created by human action. For example, Sveiby (2001, p.345) argued that strategy formulation should always start from people, as people are the true agents in organisations as "*all tangible physical products, assets as well as the intangible relations, are results of human action and depend ultimately on people for their continued existence*." Through experience, organisations develop capabilities for accomplishing value-creating tasks, which require the combined effort of multiple people with specialized knowledge and skills. According to Grant (1996) the integration of knowledge and skills across organisations is accomplished through hierarchical coordination, and more specifically, four means: i) rules and directives, ii) sequencing, iii) routines, and iv) group roles and decision-making. From

these, routines are, particularly, of interest. Although individual organisational members can leave, the routine, as a repository of *organisational* knowledge, stays (e.g. Aime *et al.*, 2010). For example, while organisations may employ rules and directives as standards for the interactions between individuals, routines guide these interactions without any formal rules, directives or communications (Grant, 1996). Besides routines, knowledge related assets can be stored in information systems, although their utilization usually hinges on human individuals and organisational routines.

From the vantage point of the knowledge-based view, information standards provide a means to share knowledge more effectively across organisations due to the specification of the nature of the form of interactions between individuals. Thus, information standards provide opportunities for new inter-organisational value creation. This has the potential to weaken the position of organisations whose competitive advantage rests on certain knowledge assets, such as customer data, as this information can now be acquired and shared more effectively when information exchange is standardised. At the same time, new business models may become possible, as organisations can serve as knowledge aggregators, pulling information from multiple value chain partners, and adding value by enriching and integrating previously disparate pieces of organisational knowledge (Wigand *et al.* 2005). This means that the competitive advantage may now rest with organisations with capabilities such as data analytics, rather than with those who have built long-term relationships with their transaction partners.

4. Proposition development

In retail, information standards have played an important part in the evolution of the sector. Yet, despite the widespread use of barcodes and EDI standards by retailers worldwide, we are only at the beginning of more large-scale standards development in the sector. While, for

example, barcodes have enabled retailers to receive more accurate product information and EDI the more accurate transmission of order information, many of these information standards are unique for a particular value chain and implemented to standardise knowledge sharing between particular transaction partners, rather than help with the overall integration and interoperability of actors participating in the retail sector.

Besides the sector-level benefits from information standards (e.g. Wigand *et al.* 2005), there are also customer level benefits. As advances in information technology enable retailers to more accurately understand the behaviour of individual customers (Bradlow *et al.* 2017), customers also now expect increasingly detailed and accurate product information, regarding for example product source and origin (e.g. Saarijärvi *et al.* 2019). However, due to the limited standardization of both information representation and transmission protocols, retailers are yet unable to deliver much of this information and respond to the needs of more demanding customers. For example, existing standards enable manufacturers and retailers to represent and share information about a particular product or product category, but not detailed information about individual product units (Zhou, 2009). As such, there is yet no universal information representation and transmission protocol in place in the sector despite the efforts of global standard-setting organisations, as well as consultants and technology providers. The risk is that in the future, this will mean that '*local'* information standards will govern the interactions and tractions in specific segments of the retail value chain.

In the following, we present an analysis of what the possible introduction of either a '*global'* or '*local'* information standard could mean for actors participating in the retail value chain based on the literature review. As retail has become increasingly data-driven, we predict that

two potential scenarios may arise in the future through the adoption of more elaborate systems of standards:

1) Retailers implement '*global'* information standards to standardise information exchange across the retail value chain, spearheaded by global standard-setting organisations (e.g. GS1, ISO), as well as consultants and technology providers.

2) Retailers implement '*local'* information standards to standardise information exchange between particular transaction partners in specific segments of the retail value chain, usually spearheaded by several large retailers (e.g. *Alibaba*, *Amazon*) or organisational consortia (e.g. *BRC*).

Considering a stylized model of a retail value chain, consisting of (i) manufacturers and (ii) wholesalers and retailers, we hypothesize about the impact of the introduction of '*global'* or '*local'* information standards on the distinct actors participating in the retail value chain. Although we limit our analysis to a stylized model of the retail value chain, we understand that in reality, retail and wholesale operations can be integrated (e.g. *Walmart*), and wholesalers can be engaged in manufacturing (i.e. private labels), to give just a couple of examples of the real-world complexities of retail trade. The simplified model is used here to simply illustrate the potential effects of information standards on the structure and power relations in the sector.

Based on our analysis, we next introduce four propositions on the effects of the introduction of '*global'* or '*local'* information standards on the retail sector based on transaction cost economics and the knowledge-based view of the firm. This analysis is considerably influenced

by Wigand *et al.* (2005), and their study on the introduction of information standards in the US home mortgage sector.

4.1 Transaction Cost Perspective to Information Standards

'*Global'* information standards mean that all information shared across the retail value chain (e.g. product and order information) is standardised, which reduces transaction costs across the retail value chain and the need for transaction partner-specific investments.

For manufacturers, '*global'* information standards lower the cost of exporting goods and thus they open access to new markets and exchange opportunities (e.g. Ranganathan *et al.* 2018). In cases where the information standards are identical or similar in both the home country and export country, manufacturers can export their goods without having to make large country-specific investments in information systems (Zhao and Xia, 2014). However, the downside of '*global'* information standards is that manufacturers likely face increasing domestic competition from foreign manufacturers who, thanks to information standards, can now enter the home market of the domestic manufacturer and thus have lower barriers for entry to new markets. Through online and digital channels, market entry decisions can practically happen overnight with little planning or investment needed if information exchange is standardised (e.g. Kim and Mahoney, 2006).

For wholesalers and retailers, *'global'* information standards provide the means to increase competition upstream in the value chain according to the logic above, opening up new markets and exchange opportunities (e.g. Ranganathan *et al.* 2018). However, since both wholesaling and retailing are highly capital-intensive businesses, lowering the information systems-related

costs of market entry may not be the decisive factor in shaping the patterns of market entry across national borders (e.g. Wigand *et al.* 2005). Also, information standards enable the pooling of supply and demand-side data to obtain a more comprehensive view of the market (Dalmolen *et al.*, 2015). Furthermore, both wholesalers and retailers need to be aware that information standards may lead to new business models and channels to arise in which manufacturers can trade with consumers directly. Therefore, we set forth the following proposition:

Proposition 1a) *'Global'* information standards increase growth opportunities and lower barriers to entry across the retail value chain.

In contrast, '*local'* information standards mean that all information shared between particular transaction partners (e.g. product and order information) is standardised in a specific segment in the retail value chain. Next, we consider how this affects manufacturers, wholesalers, and retailers.

For manufacturers, '*local'* information standards enable manufacturers to be more closely integrated with a particular transaction partner and thus increase their transactional efficiency. As a downside of this integration is the high cost of the transaction partner-specific investments and the strategic risk associated with asset specificity (Williamson, 1991b). Besides, another downside for manufacturers is information asymmetry, as manufacturers will have a limited view of the market compared to retailers and wholesalers (Dalmolen *et al.*, 2015). This may lower manufacturers bargaining power.

For wholesalers and retailers, '*local'* information standards enable closer integration with manufacturers and lock-in. Also, '*local'* information standards may increase the bargaining power of wholesalers and retailers over manufacturers (e.g. Dalmolen *et al.* 2015). As a downside of this integration is the loss of the potential pool of manufacturers, as not all manufacturers are likely willing to make the large transaction partner-specific investments required to adopt the '*local'* information standard i.e. increasing the barriers of entry to the specific value chain (Williamson 1991b). Wholesalers and retailers also face costs from standards development, and there is a risk that by focusing on the development of '*local'* information standards, they are locked out of industry-level standards development work, including, access to the newest technologies (e.g. Uotila *et al.* 2017). In the long-term, a '*local'* information standard may, therefore, be a strategic risk for wholesalers and retailers. Therefore, we set forth the following proposition:

Proposition 1b) *'Local'* information standards increase efficiency and lock-in between particular transaction partners, which limits growth opportunities to specific segments in the retail value chain and increases barriers to entry.

4.2 Knowledge-Based View Perspectives to Information Standards

'*Global'* information standards mean that information exchange is standardised across the retail value chain, and thus such standards facilitate knowledge sharing across the sector.

'*Global'* information standards may create vertical changes in the retail value chain in two distinct ways. First, *'global'* information standards can enable vertical disintermediation (Jacobides, 2005). Over the past couple of decades, information standards have allowed

vertically integrated retail chains (e.g. *Walmart, Tesco)* to gain an edge over independent retailers and wholesalers transacting at arm's length, as wholesale and retail operations can now be guided effectively in an integrated manner with supply and demand-side data (e.g. Valorinta, 2009). As a result, '*global'* information standards such as EAN codes, have led to a win-win situation where both retailers and wholesalers have been able to maximize efficiency and minimize costs, and the adoption of more elaborate systems of standards will likely fuel these effects even further (e.g. Levy and Grewal, 2000).

Secondly, *'global*' information standards can enable the emergence of new entrants and intermediaries in the market. For example, Jacobides (2005) argued that information standards can enable new '*vertical specialists'* to adopt novel roles in the value chain, creating new value but also grabbing value from others. Information standards allow new information aggregators to pool data and create business models around monetizing those data. For example, a mobile application *Ethical Barcode*[1] utilizes the product information embedded in barcodes to help consumers gain information about the '*ethicality'* of products. While traditionally, retailers have provided consumers with the needed information about products, new vertical specialists can enrich product information to give deeper insights to consumers about products and undermine the retailer as the primary source of information regarding aspects such as product source, safety, and characteristics (e.g. Saarijärvi *et al.* 2019). As consumers continue to be increasingly health and nutrition-conscious, the use of more advanced data analytics tools, such as machine learning, can also further help new vertical specialists to enter the retail market and launch business models centred on customer data and digital services (e.g. Bradlow *et al.* 2017). Therefore, we set forth the following proposition:

[1] See: http://ethicalbarcode.com/ [Accessed 2.5.2019]

Proposition 2a) *'Global'* information standards increase knowledge sharing across the retail value chain, which promotes business model innovation for all actors.

In contrast, '*local'* information standards mean that information exchange is standardised between particular transaction partners, which facilitates knowledge sharing in a specific segment in the retail value chain but not at the sector level.

'*Local'* information standards may also create vertical changes in the retail value chain in two distinct ways. First, '*local'* information standards may enforce information asymmetry. By implementing '*local'* information standards to facilitate knowledge sharing between particular transaction partners, retailers and wholesalers are only able to gather data from a specific segment in the value chain and as a result, have a limited view of the market (Williamson, 199b). However, compared to manufacturers, retailers and wholesalers have an information advantage due to the ability to aggregate both supply and demand-side data from their retail operations. As a result, there is large information asymmetry across the retail value chain, which wholesalers and retailers can use to their advantage, for example, in negotiations with manufacturers. Particularly small manufacturers may, therefore, be especially vulnerable given the large transaction partner-specific investments needed to adopt the '*local'* information standard (e.g. Zhao and Xia, 2014). For example, while retailers like *Tesco* sell anonymized transaction data to manufacturers (e.g. Humby, 2008), such practices can lead to power shifting from small to large manufacturers, who often have the in-house capabilities and skills to analyze and acquire such data, unlike others.

Secondly, *'local'* information standards may decrease business model innovation and the entry of competing organisational forms. As the entry cost to a closed value chain with a '*local'*

information standard is higher, new manufacturers may prefer to join open rather than closed value chains which means that retailers and wholesalers will likely struggle to attract new manufacturers to transact with (e.g. Williamson, 1991b). Inherently this means that while some manufacturers may choose to make the transaction partner-specific investments in the '*local'* information standard and specialize in working with a particular retailer and wholesaler, the majority of manufacturers will likely continue to prefer to join open value chains and work with many retailers and wholesalers rather than closer integration with a particular transaction partner. On the other hand, *'local'* information standards may restrict business model innovation due to the inability to access sector-level data (Jacobides, 2005). '*Local'* information standards, therefore, may direct firms innovation activities to only take place in specific segments in the retail value chain. Thus, in the short term '*local'* information standards may enable actors in the retail value chain to sustain their competitive advantage, but in the long-term may make them particularly vulnerable to larger disruptions taking place at the sector-level. Therefore, we set forth the following proposition:

Proposition 2b) '*Local'* information standards increase knowledge sharing between particular transaction partners, which limits business model innovation to specific segments of the retail value chain.

5. Discussion and Conclusions

The retail sector is undergoing a period of large change, where the previously dominant model in which manufacturers, wholesalers and retailers were integrated and more effectively coordinated, is being replaced by one in which supply and demand-side data are critical and all other capabilities and capacities are often contracted from the market (Hänninen *et al.* 2019).

In this study, we have therefore argued that actors participating in the retail value chain need to understand the critical role that information standards play in shaping the norms of inter-organisational collaboration and information exchange in the retail sector, and the implications that information standards may have on the structure and power relations across the retail value chain (e.g. Dalmolen *et al.* 2015). We, therefore, contribute to retail research by moving the retail literature beyond discussing the impact of specific technologies on distinct actors across the retail value chain, to considering the sector-level implications of information standards, particularly, the more elaborate systems of standards currently spearheaded by a number of standard-setting bodiess and consortia, in addition to consultants and technology providers.

5.1 Theoretical Implications

As our analysis shows, '*global'* information standards arguably increase supply-chain efficiency and transparency, and the increased use of information standards promises to fuel the transformation of retail towards increasingly data-driven modes of operation. However, although the sector level benefits of '*global'* information standards are obvious, for example, as information standards promote transparency across the retail value chain, the development and adoption of more advanced information standards can have disruptive effects on the structure of the sector, especially if such developments are spearheaded by many competing parties (e.g. Jacobides, 2005). The risk is that rather than a '*global'* standard for information exchange emerging, adopted by a majority of leading retailers worldwide, and spearheaded by both global standard-setting bodiess, as well as consultants and technology providers, a number of '*local'* information standards may emerge which only ensure the interoperability of particular transaction partners in specific segments in the retail value chain. While a '*global'* information standard may result in a positive reinforcing cycle of adoption as actors

participating in the retail value chain have no real choice of opting-out of the standard to ensure interoperability with their ecosystem, '*local'* information standards are, conversely, never intended to become universal or to cover the interoperability of the entire value chain. As such, we argue that managers of organisations operating across the retail value chain need to be aware of two ways in which information standards, both '*global'* or '*local'*, may represent a two-bladed sword (e.g. Wigand *et al.* 2004).

First, '*global'* information standards generally make foreign market entry easier and enable increasing competition upstream in the value chain, leading to gains in both growth and efficiency (Ranganathan *et al.* 2018). At the same time, however, information standards can enable *rival* organisations to enter the focal organisation's market, leading to losses in margins and increased competition due to lower market entry barriers. On the other hand, '*local'* information standards may increase efficiency and lock-in particular transaction partners but may pose a strategic risk when they bind transaction partners together at the cost of openness and interoperability.

Second, *'global'* information standards facilitate knowledge sharing across organisations, enabling incumbent organisations to engage in business model innovation. However, this benefit is offered to *other* incumbent organisations as well, including potential new entrants, leading to a risk of disruptive change in the retail sector (Jacobides, 2005). *'Local'* information standards, on the other hand, may induce information asymmetry as information sharing is standardised only between particular transaction partners. Accordingly, '*local'* information standards may restrict business model innovation and the entry of competing organisational forms, as it is difficult for new manufacturers to enter a closed value chain and access supply and demand-side data. While '*global'* information standards enable particularly new entrants

to innovate, in the case of '*local'* information standards innovation activities are limited to specific segments of the retail value chain.

While the benefits of '*global'* information standards, in contrast to '*local'* information standards, are obvious, and well documented in the literature, it is important to note that '*global'* standards also carry plenty of risk. For any single firm participating in the retail value chain, any gains from participating in standards development and implementing new '*global'* information standards is relatively small and specific, as standards, more or less, contribute to the greater good, without necessarily significantly improving the profitability of any single actor in the retail value chain. Indeed, it is likely that more actors will lose out from the adoption of a suboptimal standard, then benefit from the adoption of an optimal one. It is also important to note that when standards development is spearheaded by a number of large, influential players, such as consultants (e.g., The Big Four) or technology companies (e.g., Alphabet, IBM), the individual actor participating in the retail value chain may have little choice about if and what standard they will adopt, particularly once a dominant standard emerges.

5.2 Practical Implications

At the outset, it is difficult to say which of these consequences of information standards will materialize. This offers a fruitful direction for future research. In the meanwhile, managers of organisations participating in the retail value chain must carefully consider the potential strategic risks associated with the development and adoption of information standards, including the risk that organisations like *Alibaba* or *Amazon* will take a more active role in setting '*local'* information standards in the future to coincide and rival with '*global'* standards development, at the hands of global standard setting bodies, as well as consultants and

technology providers. However, at the same time it should be noted that although the standardization of information exchange can lead to increasing competition and disruptive change across the sector, incumbent organisations might be unable to stop the development and adoption of information standards. For example, technologies like blockchain and DLT can have disruptive effects on the structure of the retail sector especially if their development is out of the influence of both incumbent actors in the retail value chain and global standard-setting organisations, and associated actors (e.g. Iansiti and Lakhani, 2017). Therefore, participation in standards development and adoption can be necessary but not sufficient to ensure company survival and prosperity in the long term.

5.3 Limitations and Future Research

This paper has outlined an overall framework for understanding the sector level consequences of information standards and introduced four propositions to describe their potential effects and outcomes. This approach is intendedly general and certain details have been omitted for this reason. Therefore, the focus of the research has been, rather than providing a complete review of the existing literature on information standards and their potential effects across the retail value chain, on providing a conceptual framework and analysis based on relevant research. There is, therefore, much need for further research on information standards across the retail value chain and particularly on the potential scenarios that their adoption may lead to.

References

Aastrup, J., Grant, D.B. and Bjerre, M., 2007. Value creation and category management through retailer–supplier relationships. International Review of Retail, Distribution and Consumer Research, 17(5): 523-541.

Achabal, D.D. and McIntyre, S.H. 1987, "Information technology is reshaping retailing", *Journal of Retailing* 22 (4): 321-325.

Ailawadi, K.L. and Farris, P.W. 2017, "Managing multi-and omni-channel distribution: metrics and research directions", *Journal of Retailing* 93 (1): 120-135.

Aime, F., Johnson, S., Ridge, J.W. and Hill, A.D., 2010, "The routine may be stable but the advantage is not: Competitive implications of key employee mobility", *Strategic Management Journal 31* (1): 75-87.

Agarwal, R., and Dhar, V. 2014, "Editorial – big data, data science, and analytics: the opportunity and challenge for is research", *Information Systems Research* 25 (3): 443–448.

Amazon.com. 2019, "Transparency", Available at: https://brandservices.amazon.com/transparency [Accessed 27th of February, 2019]

Argote, L. and Ingram, P. 2000, "Knowledge transfer: A basis for competitive advantage in firms", *Organizational Behavior and Human Decision Processes 82* (1): 150-169.

Bala, H. and Venkatesh, V. 2007, "Assimilation of interorganizational business process standards. *Information Systems Research"* 18 (3): 340-362.

Banerjee, M. 2014, "Misalignment and its influence on integration quality in multichannel services". *Journal of Service Research*, 17(4): 460-474.

Beck, Jonathan, Michal Grajek and Christian Wey (2005), Hypermarket competition and the diffusion of retail checkout barcode scanning, CEPR Discussion Paper 5386.

Berry, C., Mukherjee, A., Burton, S. and Howlett, E. 2015, "A COOL effect: The direct and indirect impact of country-of-origin disclosures on purchase intentions for retail food products", *Journal of Retailing 91* (3): 533-542.

Boh, W.F. and Yellin, D. 2006, "Using enterprise architecture standards in managing information technology", *Journal of Management Information Systems* 23 (3): 163-207.

Bradlow, E.T., Gangwar, M., Kopalle, P. and Voleti, S. 2017, "The role of big data and predictive analytics in retailing", *Journal of Retailing* 93 (1): 79-95.

Brown, J.R., Dant, R.P., Ingene, C.A. and Kaufmann, P.J. 2005, "Supply chain management and the evolution of the "Big Middle"", *Journal of Retailing* 81 (2): 97-105.

Casadesús, M., Viadiu, F.M. and Saizarbitoria, I.H. (2002), "Quality service of ISO 9000 consultants", *International Journal of Quality & Reliability Management*, 19 (8/9): 980-1013.

Chakravarti, A. and Xie, J., 2006, "The impact of standards competition on consumers: Effectiveness of product information and advertising formats", *Journal of Marketing Research* 43 (2): 224-236.

Coase, R.H. 1937, "The nature of the firm. *Economica"* 4 (16): 386-405.

Cohen, W.M. and Levinthal, D.A. 1990, "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly 35* (1): 128-152.

Conner, K.R., 1991, "A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm?", *Journal of management* 17 (1): 121-154.

Dalmolen, S., Moonen, H., van Hillegersberg, J. 2015, "Industry-wide Inter-organizational Systems and Data Quality: Exploratory Findings of the Use of GS1 Standards in the Dutch Retail Market", AMCIS 2015 Proceedings.

Daunfeldt, S.O. and Rudholm, N., 2014, "Does shelf-labeling of organic foods increase sales? Results from a natural experiment", *Journal of Retailing and Consumer Services 21* (5): 804-811.

Dawson, J.A., 1994. Applications of information management in European retailing. International Review of Retail, Distribution and Consumer Research, 4 (2): 219-238.

Ellis, B. and Kelley, S.W. 1992, ”Competitive advantage in retailing”, *International Review of Retail, Distribution and Consumer Research* 2 (4): 381-396.

Evans, L. and Kitchin, R. 2018, ”A smart place to work? Big data systems, labour, control and modern retail stores”, *New Technology, Work and Employment* 33(1): 44-57.

Fiorito, S.S., Gable, M. and Conseur, A. 2010, ”Technology: advancing retail buyer performance in the twenty-first century”, *International Journal of Retail & Distribution Management 38* (11/12): 879-893.

Gallino, S. and Moreno, A. 2014, ”Integration of online and offline channels in retail: The impact of sharing reliable inventory availability information”, *Management Science 60* (6): 1434-1451.

Garud, R., Jain, S. and Kumaraswamy, A. 2002, ”Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java”, *Academy of Management Journal* 45 (1): 196-214.

Grant, R.M. 1996. ”Toward a knowledge-based theory of the firm”, *Strategic Management Journal* 17 (2): 109-122.

Grewal, D., Ailawadi, K.L., Gauri, D., Hall, K., Kopalle, P. and Robertson, J.R. 2011. ”Innovations in retail pricing and promotions”, *Journal of Retailing* 87 (1): 43-52.

Grewal, D., Roggeveen, A.L. and Nordfält, J. 2017, ”The future of retailing”, *Journal of*

Retailing 93 (1): 1-6.

Hagberg, J., Sundstrom, M. and Egels-Zandén, N. 2016, ”The digitalization of retailing: an exploratory framework”, *International Journal of Retail & Distribution Management* 44 (7): 694-712.

Hollander, S. and Omura, G. 1989, ”Chain Store Developments and Their Political, Strategic, and Social Interdependencies”, *Journal of Retailing* 65 (3): 299-325.

Humby, C., Hunt, T., and Phillips, T. 2008, ”Scoring points: How Tesco continues to win customer loyalty”. London, UK: Kogan Page.

Hänninen, M., Mitronen, L. and Kwan, S.K. 2019, ”Multi-sided marketplaces and the transformation of retail: A service systems perspective”, *Journal of Retailing and Consumer Services 49*: 380-388.

Iansiti, M., and Lakhani, K. R. 2017, ”The Truth About Blockchain”. *Harvard Business Review*, 95 (1): 118–127.

Jacobides, M.G. 2005, ”Industry change through vertical disintegration: How and why markets emerged in mortgage banking”, *Academy of Management Journal 48* (3): 465-498.

Kim, S.M. and Mahoney, J.T. 2006, ”Mutual commitment to support exchange: relation-specific IT system as a substitute for managerial hierarchy”, *Strategic Management Journal* 27 (5): 401-423.

Kjellberg, H., Hagberg, J. and Cochoy, F., 2019, “Thinking Market Infrastructure: Barcode Scanning in the US Grocery Retail Sector, 1967–2010”, In Thinking infrastructures. Emerald Publishing Limited.

Kopalle, P.K., Fisher, R.J., Sud, B.L. and Antia, K.D. 2017, ”The effects of advertised quality emphasis and objective quality on sales”, *Journal of Marketing* 81 (2): 114-126.

Leiblein, M.J. and Miller, D.J. 2003, ”An empirical examination of transaction-and firm-level influences on the vertical boundaries of the firm”, *Strategic Management Journal 24* (9): 839-859.

Leiponen, A.E. (2008), ”Competing through cooperation: The organization of standard setting in wireless telecommunication”, *Management Science* 54 (11): 1904-1919.

Levy, M. and Grewal, D. (2000), ”Supply chain management in a networked economy”, *Journal of Retailing 76* (4): 415-429.

Lyytinen, K. and King, J.L. 2006, ”Standard making: a critical research frontier for information systems research”, *MIS Quarterly* 30: 405-411.

Marakas, G.M. 1999, ”Decision Support Systems in the Twenty-first Century”, Prentice-Hall, Englewood Cliffs, New Jersey, NJ.

McEvily, S.K. and Chakravarthy, B. 2002, ”The persistence of knowledge-based advantage: an empirical test for product performance and technological knowledge”, *Strategic Management Journal, 23* (4): 285-305.

Müller-Seitz, G., Dautzenberg, K., Creusen, U. and Stromereder, C. 2009, ”Customer acceptance of RFID technology: Evidence from the German electronic retail sector”, *Journal of Retailing and Consumer Services, 16* (1): 31-39.

Nikolaeva, R. 2006, ”E-commerce adoption in the retail sector: empirical insights,” *International Journal of Retail & Distribution Management* 34 (4/5): 369-387.

Oh, H., Ivezic, N. and Nieman, S.T. 2019, ”Standards-based semantic integration of manufacturing information: Past, present, and future”, *Journal of Manufacturing Systems* 52: 184-197.

Piotrowicz, W. and Cuthbertson, R. 2014, ”Introduction to the special issue information technology in retail: Toward omnichannel retailing”, *International Journal of Electronic Commerce*, 18 (4): 5-16.

Ranganathan, R., Ghosh, A. and Rosenkopf, L., 2018, ”Competition–cooperation interplay during multifirm technology coordination: The effect of firm heterogeneity on conflict and consensus in a technology standards organization”, *Strategic Management Journal 39* (12): 3193-3221.

Reardon, J., Hasty, R. and Coe, B. 1996, ”The effect of information technology on productivity in retailing”, *Journal of Retailing 72* (4): 445-461.

Renko, S. and Druzijanic, M. 2014, ”Perceived usefulness of innovative technology in retailing: Consumers′ and retailers′ point of view”, *Journal of Retailing and Consumer Services 21* (5): 836-843.

Rugman, A.M. and Verbeke, A. 2002, ”Edith Penrose's contribution to the resource-based view of strategic management”, *Strategic Management Journal* 23 (8): 769-780.

Saarijärvi, H., Sparks, L. and Lahtinen, S. 2019, ”Food, health, and data: Developing transformative food retailing”. In *Case Studies in Food Retailing and Distribution* (pp. 189-204). Woodhead Publishing.

Savastano, M., Bellini, F., D’Ascenzo, F. and De Marco, M. (2019), ”Technology adoption for the integration of online–offline purchasing: Omnichannel strategies in the retail environment”, *International Journal of Retail & Distribution Management* 47 (5): 474-492.

Senge, P. (1990), ”The Art and Practise of the Learning Organization”. Doubleday, Garden City, NY.

Shelanski, H.A. and Klein, P.G. 1995, ”Empirical research in transaction cost economics: a review and assessment”, *Journal of Law, Economics, and Organization*: 335-361.

Sveiby, K.E. 2001. ”A knowledge-based theory of the firm to guide in strategy formulation”, *Journal of Intellectual Capital 2 (4):* 344-358.

ter Braak, A. and Deleersnyder, B. 2018, ”Innovation Cloning: The Introduction and Performance of Private Label Innovation Copycats”, *Journal of Retailing 94* (3): 312-327.

Uotila, J., Keil, T. and Maula, M. 2017, ”Supply-side Network Effects and the Development of Information Technology Standards”, *MIS Quarterly* 41 (4): 1207-1226.

Valorinta, M. (2009), ”Information technology and mindfulness in organizations”, *Industrial and Corporate Change 18* (5): 963-997.

Vijayasarathy, L.R. and Tyler, M.L. 1997, ”Adoption factors and electronic data interchange use: a survey of retail companies”, *International Journal of Retail & Distribution Management* 25 (9): 286-292.

Waguespack, D.M. and Fleming, L. 2009, ”Scanning the commons? Evidence on the benefits to startups participating in open standards development”, *Management Science 55* No. (2): 210-223.

Watson, B.C., 2011, “Barcode empires: politics, digital technology, and comparative retail firm strategies”, *Journal of Industry, Competition and Trade*, 11 No. (2): 309-324.

Wigand, R.T., Steinfield, C.W. and Markus, M.L. 2005, ”Information technology standards choices and industry structure outcomes: The case of the US home mortgage industry”. *Journal of Management Information Systems* 22 (2): 165-191.

Wilcox King, A. and Zeithaml, C.P. 2003, ”Measuring organizational knowledge: a conceptual and methodological framework”, *Strategic Management Journal 24* (8): 763-772.

Williamson, 0. E. 1975, ”Market and Hierarchies: Antitrust Implications”, New York: The Free Press

Williamson, O.E. 1991a, ”Comparative economic organization: The analysis of discrete structural alternatives”, *Administrative Science Quarterly*: 269-296.

Williamson, O.E., 1991b, ”Strategizing, economizing, and economic organization”, *Strategic Management Journal 12* (2): 75-94.

Williamson, O.E. 1993, ”Transaction cost economics and organization theory”, *Industrial and Corporate Change* Vol. *2* No.2, pp.107-156.

Zhao, K., Xia, M. and Shaw, M.J. 2007, ”An integrated model of consortium-based e-business standardization: Collaborative development and adoption with network externalities”, *Journal of Management Information Systems* 23 (4): 247-271.

Zhao, K. and Xia, M. 2014, ”Forming interoperability through interorganizational systems standards”, *Journal of Management Information Systems* 30 (4): 269-298.

Zhou, W. 2009, ”RFID and item-level information visibility”, *European Journal of Operational Research 198* (1): 252-258.

Tables

	GTIN	EDI	EPC	GDSN
Name	Global trade item number	Electronic data interchange	Electronic product code	Global data synchronization data
Introduced	1974	1975	1999	2004
Type of standard	Barcode	Data interchange	Product code	Global standard
Type of information standardised	Product	Information	Location	Product
Use of standard	Identification	Transferability	Tracking	Identification
Scope	Internal	Value chain	Internal	Value chain
Implementation cost	Low	Low	Medium	High
Adoption rate	High	High	Low	Low

Table 1. Characteristics of Some Existing Standards in the Retail Sector