

The emergence and adoption of digitalization in the logistics and supply chain industry: an institutional perspective

The emergence and adoption of digitalization

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Abstract

Purpose – Despite increasing interest in digital services and products, the emergence of digitalization in the logistics and supply chain (L&SC) industry has received little attention, in particular from organizational theorists. In response, taking an institutionalist view, the authors argue that the emergence and adoption of digitalization is a socially constructed phenomenon.

Design/methodology/approach – This paper shows how actor-level frameshifts contribute to an emergence of an overarching “digitalization logic” in the L&SC industry at the field level. Building on a longitudinal analysis of field actors’ frames and logics, the authors track the development of digitalization over the last 60 years in the L&SC sector.

Findings – The authors classify specific time periods by key field-configuring events, describe the relevant frameshifts in each time period and present a process that explains how and why digitalization has emerged, been adopted and manifested itself in the L&SC industry.

Originality/value – The findings of the study provide insights about the evolution of a digitalization logic and thus advance the institutional view on digitalization in the L&SC industry.

Keywords Logistics, Supply chain, Institutional theory, Institutional logics, Digitalization

Paper type Research paper

1. Introduction

Digitalization in the logistics and supply chain management (L&SC) industry is of increasing strategic importance for businesses as it impacts established paradigms, business models and industry boundaries (Barrett *et al.*, 2015; Cichosz *et al.*, 2020). A mounting number of companies allocate resources to exploit digital opportunities that have the potential to transform societies, economies and organizations (Cichosz *et al.*, 2020; Hribernik *et al.*, 2020; Mikl *et al.*, 2020b). However, digitalization in L&SC seems to be a double-edged sword: on the one part, companies such as Amazon have fundamentally changed the L&SC landscape through digital products and services (Cohen, 2018; Liebmann, 2013), thus having embraced and pushed digitalization as a force of change, not only between institutions, organizations

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and companies but also as an opportunity to create completely new products and services (Loebbecke and Picot, 2015). On the other part, traditional L&SC companies such as sea or rail freight forwarder are still characterized by low levels of digitalization and manual processes (Economist, 2018), thus risking to miss out on digital advances (see, e.g. Lyall *et al.*, 2018) that “[rewrite] the rules of business and supply chains” (O’Marah, 2017).

Although research in digitalization in L&SC is an increasingly popular topic among academics (e.g. Busse and Wallenburg, 2011; Cichosz *et al.*, 2020), little understanding exists “how the digital revolution will impact key [L&SC] concepts” (Stank *et al.*, 2019, p. 957). In particular, the topic of how digitalization has emerged and manifested itself in L&SC has received only little attention, in particular from organizational theorists and business historians. So far, there is only limited research available investigating the change through digitalization and what events have led to an agreement in organizations and companies to put digitalization on the agenda in the L&SC industry.

In line with Orlikowski and Barley (2001), we argue that institutional theory has relevant concepts and constructs that can help us understand the emergence and the adoption of digitalization and its impact on L&SC. An institutional perspective on digitalization allows us to understand digitalization as a socially constructed process in which key actors in L&SC eventually reach convergence around a so-called “digitalization logic” in L&SC. In particular, by examining digitalization from an institutional perspective, this paper attempts to answer how actors in the L&SC field reach a consensus to “institutionalize” digitalization in their organizations’ practices and processes (Thornton and Ocasio, 2008). To do so, this paper uses an inductive approach to reconcile the emergence of digitalization in L&SC based on examination how digitalization has been recognized and being addressed over time. As L&SC management is subject to conflicting and competing opinions, an examination of both symbolic and cognitive elements and the implementation of organizational practices provide not only insights about how digitalization has and can influence companies but more fundamentally about whether digitalization is a phenomena that L&SC organizations need to adopt in order to gain and maintain legitimacy (Suchman, 1995) or to maintain or build a competitive advantage (Koch and Windsperger, 2017; Porter, 1985).

Our paper makes three main contributions to further advance the understanding of institutional interactions by which digitalization emerges and manifests itself in the L&SC industry. First, we conceptualize the emergence and the adoption of digitalization as a social construct, where the digitalization logic is subject to change as field-level frames show discursive behavior over time. Second, abstracting from our findings on digitalization over a period of 60 years, we identify key frames and illustrate how these frames shift and drive digitalization in L&SC. Third, our study depicts the process of the emergence, adoption and manifestation of a digitalization logic in logistics industry, thereby highlighting the key determinants behind digital and technological advances in L&SC.

The remainder of the paper is structured as follows: we first theorize about the influence of institutions and describe the underlying concepts of logics and frameshifts in the context of the L&SC industry. This is followed by a description of the research design and the method used to investigate the emergence, adoption and manifestation of the digitalization logic. Next, we present and discuss the findings and conclude with implications to theory and practice, highlight the limitations of the study and provide future research avenues.

2. An institutional perspective on digitalization in the L&SC industry

2.1 The adoption of digitalization in the L&SC industry

Digitalization plays an increasing role in the L&SC industry (Cichosz *et al.*, 2020; Mikl *et al.*, 2020a), and numerous scholars have addressed and discussed its transformation potential for societies, economies and organizations (e.g. Garay-Rondero *et al.*, 2019; Holmström *et al.*, 2019;

Seyedghorban *et al.*, 2020; Stank *et al.*, 2019; Wieland, 2020). For the purpose of this study, we base our definition of digitalization on the work of Brennen and Kreiss (2016) and Ritter and Pedersen (2020) and define digitalization as “the exploitation of new technologies with processes to gain a competitive advantage and the potential to transform the L&SC sector.” One reoccurring theme within the literature discussing the opportunities through digitalization in the L&SC industry is the adoption of digital products and services and the implementation of new technologies (Mathauer and Hofmann, 2019; North *et al.*, 2019; Verma and Bhattacharyya, 2017).

Institutionalist scholars argue that the adoption of organizational practices and measures is guided by institutions (DiMaggio and Powell, 1983; Scott, 1991; Thornton *et al.*, 2012). According to Djelic and Quack (2008), these institutions represent “collective frames and systems that provide stability and meaning to social behavior and social interaction and take on a rule-like status in social thought and action” (p. 300). These institutions exist in organizational fields: in the context of our study, the organizational field represents the L&SC industry. In this organizational field, richly contextualized spaces exist where various actors with different interests negotiate at multiple levels over issue interpretation and often find common ground (Herold and Lee, 2019; Scott, 1991; Thornton *et al.*, 2012; Wooten and Hoffman, 2008). For example, referring again to the example from the introduction, the company Amazon seems to have found “common ground” with their suppliers and customers about the importance and the benefits of digitalization. In other words, the actors of and around Amazon have built a collective awareness that digitalization has serious implications on their organizations, while sea and rail freight forwarders seem to have not reached the same level of consensus, as their low level of digitalization indicates (Economist, 2018).

We argue that the emergence and the adoption of digitalization is a socially constructed phenomenon, in which institutional norms and practices, rather than individualized choices, motivate actors to adopt digital processes and practices (see Berger and Luckmann, 1968). In particular, the adoption of digitalization is the outcome of a process of negotiations and social interaction where the various actors in the organizational field legitimize their actions (Fischer *et al.*, 1998; Suddaby *et al.*, 2017). Legitimacy, which Suchman (1995) defines as a “generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions” (p. 574), is experienced intersubjectively – and distinctively – within actors in the organizational field (Clark, 1985; Giddens, 1984), i.e. although institutions guide the processes and behaviors, in practice, companies adopt digitalization in different ways, time frames or not at all. From an institutional perspective, the emergence and adoption is thus related “to the ways in which legitimacy of particular ways of organizing become tied to issues of existing logics, power and interest” (Hinings *et al.*, 2018, p. 56, p. 56).

2.2 Understanding digitalization through institutional logics and frames

From social construction perspective, the adoption of digitalization in the L&SC industry (on the field level) can only occur when actors build a collective awareness that digitalization may represent serious opportunities or threats for their organizations (Rachinger *et al.*, 2019). Critical moments in the social construction of digitalization may occur when actors in L&SC feel being left behind or not able to control the opportunities and changes in digital technology, which then may have implications for the actors’ legitimacy or even worse their survival (Suchman, 1995). However, through the process of understanding and narrowing the scope and the significance of digitalization in the field, actors automatically engage in socially constructing digital processes and practices and, based on their sense of consensus and their logics, may begin to take collective action to determine if and how digitalization will be adopted. As such, we assert that the adoption of digitalization in L&SC as social construct involves an overarching logic: the “digitalization logic.”

According to [Scott \(2012\)](#), institutional logics reflect “values and norms, ideas, beliefs, and meaning systems that guide the behavior of actors” (p. 32). In other words, institutional logics represent the organizing principles within an organizational field shaping cognition and behavior in an industry ([Besharov and Smith, 2014](#)). Against this background, it is necessary to emphasize how different and often competing logics cause actors to frame issues distinctively and to propose particular actions ([Herold et al., 2019](#); [Purdy and Gray, 2009](#)). However, institutional logics can also coexist ([Reay and Hinings, 2009](#); [Seo and Creed, 2002](#)), recombine ([Djelic and Quack, 2008](#)) or blend ([Lounsbury, 2008](#)). This interaction between logics refers to deliberate attempts to convince other field actors to shift their frames rather than by accident as “frames function to organize experience and guide action” ([Snow et al., 1986](#), p. 464). As a consequence, field frames emerge when the various frames of actors converge around a shared frame ([Kaplan, 2008](#); [Lounsbury and Ventresca, 2003](#)).

As such, the identification of logics and frames within the organizational field provides a foundation for a dynamic and richer understanding of the influence of actors which action unfolds. Examining digitalization from an institutional view is thus about how digital-enabled institutional logics and frames emerge and diffuse both through fields and organizations ([Hinings et al., 2018](#)). In particular, frame analysis can be regarded as a useful tool to analyze how field-level actors participate in “discursive struggles” to advance their practices and logics ([Kaplan, 2008](#)). In these evolving fields exist thus the potential for the emergence and diffusion of field-level frames, such as digitalization, given that actors with conflicting frames can solve their frame discrepancies. [Hardy and Maguire \(2010\)](#) found that shifts in frames that change key actors’ perceptions are triggered by so-called key field-configuring events. According to [Sewell \(1996\)](#), a key field-configuring event can be defined as “(1) a ramified sequence of occurrences that (2) is recognized as notable by contemporaries, and that (3) results in a durable transformation of structures” (p. 844).

However, despite attempts to identifying the mechanisms that facilitate field change to advance theory from an institutional perspective, little attention has been given to examine how a digitalization logic emerges, is adopted and can manifest itself, in particular in the context of the L&SC industry. An examination of these dynamics in the field, i.e. the adoption and implementation of digitalization, provides an opportunity to better understand how a digitalization logic can emerge and manifest itself in the field. As such, this paper aims to examine to identify how actors with various logics shift frames to allow a consensus and advance the emergence, adoption and manifestation of the digitalization logic in the organizational field of L&SC.

3. Methodology

3.1 Research approach

We specifically ask one research question to advance the institutional view on digitalization in L&SC:

RQ1. How has digitalization emerged, been adopted and manifested itself in the L&SC industry?

To answer the research question, we use the construct of “institutional logics” ([Scott, 1991](#); [Thornton et al., 2012](#)) to examine the emergence and the adoption of digitalization in L&SC, i.e. how a “digitalization logic” has emerged and has been adopted. In line with institutional logics, the emergence and the adoption of a digitalization logic is based on both symbolic and cognitive elements (to recognize the issue) and the implementation of organizational practices (to address the issue) ([Thornton and Ocasio, 2008](#)). For the data collection as well as for the analysis, we adopt a so-called “historical process research” approach ([Langley, 1999](#)). In contrast to other research approaches focusing on differences, process research aims to

provide an understanding why and how “discrete events and states” (Elsbach and Sutton, 1992, p. 708) develop over time; thus, process research collects data of activities, events and decisions over time (Langley, 1999). To illustrate how digitalization emerged and manifested itself in L&SC, we applied a diachronic approach to understand the developments in the field over time and associated consensus around the digitalization logic (for a similar approach, see Ansari *et al.*, 2013).

A crucial element of the data collection was the determination of relevant actors and the classification of key field-configuring events and milestones (Hardy and Maguire, 2010) that change key actors’ perceptions about digitalization. In particular, the identification of the key field-configuring events and milestones had three specific goals: (1) to identify key historical events of digitalization in L&SC, (2) to assess the time periods when frame shifts in digitalization occurred, i.e. we looked for “discursive shifts” (Maguire and Hardy, 2009) and “breaches that reveal the usually undiscussed boundaries of taken-for-granted understandings” (Schneiberg and Clemens, 2006, p. 214) and (3) determine the key actors that affect and are affected by the emergence of digitalization.

In order to determine these key events and actors, we conducted three group discussions “to stimulate discussion and thereby understand (through subsequent analysis) the meanings and norms which underlie those group answers” (Bloor *et al.*, 2001, pp. 42–43). The first group consisted of five academic L&SC experts from Central and Eastern Europe; the second group comprised five L&SC practitioners from Central and Eastern Europe, each with more than 10 years’ experience in the industry. In particular, academic participants were chosen on the basis of their experience and standing in academic community, i.e. senior academic researchers or university professors with an associated publication track record with a focus on technologies, digitalization or entrepreneurship in the field of logistics or supply chains. Practitioners were chosen based on their experience in medium-to-large multinational corporations and their area of responsibility, i.e. being part of senior management with an international track record in L&SC and having strategic and operational management experience as well as an involvement in technology or digitalization projects.

In the first and second group discussion, the respective participants were asked to name and describe significant events and milestones in the emerging field of digitalization, the rationale behind these events and how it affected the actors’ perceptions about digitalization in the last 60 years, i.e. from the years 1960 to 2020. 1960 was chosen as starting point as it represents the start of so-called “Logistics 2.0” era, i.e. the start of the digitalization in L&SC (Frazzon *et al.*, 2019). The group discussions lasted between 60 and 90 min until all participants agreed with identified events and milestones. The feedback of each group was then consolidated to compare the results. The results were discussed internally between the researchers to identify overlaps and differences, which allowed us to create a preliminary list of digitalization events and milestones. In the third group discussion, we presented the preliminary list and invited both groups to further consolidate the events and milestones that were seen as the key field-configuring events in digitalization in the L&SC industry, which led to the final list of events and milestones in the field of L&SC digitalization.

At the same time, secondary data were collected to track old and new developments in digitalization and in the L&SC industry. According to Rabinovich and Cheon (2011), the use of secondary data has some unique advantages, for example, it is less subject to biases, has higher internal validity and is available in great quantity. Following a rigorous methodological approach (see, e.g. Denyer and Tranfield, 2009; Durach *et al.*, 2017), an inclusion criteria list was developed and agreed on by all authors. We decided to not restrict the search to academic papers but also include nonacademic articles as scholars encourage researchers to include wide range of studies (McKinnon, 2013; Pawson, 2006; Tranfield *et al.*, 2003).

For academic papers, we focused on peer-reviewed articles as they are considered to be higher quality than nonpeer-reviewed articles (Denyer and Tranfield, 2009). To reduce bias, two databases were selected for the literature search: Scopus and Web of Science. These databases were selected as they represent large repositories of business research, providing a broad range of publishing outlets of highest impact for the research community (Sandberg and Aarikka-Stenroos, 2014). Furthermore, Google Scholar was also used to confirm/double-check the relevant list of peer-reviewed articles. We used the main keywords “digitalization” in combination with “supply chain” and “logistics” but in order to expand our scope and include as many relevant articles as possible, we repeated the search and replaced “digitalization” with related terms such as “technology,” “ICT,” “big data” or “computer” and added keywords including “adoption,” “implementation” or “diffusion.”

We used academic papers for two purposes. First, we further sighted studies that may help us to further deconstruct the emergence of digitalization and their associated concepts to better understand their implications on frameshifts and field-level changes. Second, we used recent papers to reflect on the key actors behind the emergence to better understand how organizations companies adopt a digitalization logic. For nonacademic papers, we used the keywords to identify any relevant information in consultancy or industry reports, press releases, websites, newspapers and magazines not only to support our arguments but also to substantiate and validate the identified key field-configuring events and milestones. These articles dealt with the impacts of digitalization and described events and milestones that had an influence on companies, consumers and state actors. With the help of these data sets, we were able to triangulate and determine specific key field-configuring events and the key actors’ frames.

3.2 Data analysis and presentation of results

The analysis of the data occurred in four steps: (1) the determination of the actors that affect or are affected by digitalization in L&SC, (2) the chronological identification of historical events, (3) the identification of key-configuring events and (4) the discussion of the interrelations to display the process behind the emergence, the adoption and the manifestation of the digitalization logic. All four steps were predominantly based on the findings from the group discussion but were complemented, validated and interpreted with the help of the collected secondary data.

First, we identified key actors that had a direct influence on digitalization but also actors who indirectly influenced the digitalization in L&SC. In this step, we did not restrict the term “key actors” to any definition, allowing to incorporate a wide range of relevant influences. Second, we derived key historical digitalization events in L&SC from the group discussions and the complementary secondary data: the historical events started with the introduction of electronic data interchange (EDI), which was one of crucial applications within the era of containerization and ended with the IBM–Maersk blockchain application in 2018. Overall, 13 events in the history of digitalization in L&SC were classified. After identifying the historical events, we investigated as a third step the field-configuring events that led to changes within the organizational field. In particular, we examined the frames within these event periods and assessed the extent of a shift in frames. Taking into account the group discussions and the secondary data, we identified 12 actor-level frameshifts.

As the fourth and last step, we examined the field frameshifts’ interrelations to identify conditions under which a consensus was built to within the field that led to the emergence, adoption and manifestation of the digitalization logic in L&SC. To differentiate and classify the frames, we followed two steps: (1) we compared the emergence, adoption and the manifestation of digitalization logic between the industries related to L&SC and other industries, thereby not only highlighting the interrelations and the indirect influences on L&SC but also showing the similarities and differences between the industries and (2) used

the terms “Industry 2.0” until “Industry 4.0” and “L&SC 2.0” until L&SC 4.0 to showcase the development of the digitalization logic, thereby displaying a clear classification of the field frames and the process of the emergence, adoption and the manifestation of digitalization logic in L&SC.

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4. Results

As described above, the results are presented in four steps: (1) the determination of the actors that affect or are affected by digitalization in L&SC, (2) the chronological identification of historical events, (3) the identification of key configuring events and (4) the discussion of the interrelations to display the process behind the emergence, the adoption and the manifestation of the digitalization logic. Each step will be discussed in detail below.

4.1 Key actors in logistics and supply chain’s digitalization

As a first step, we identified the relevant actors that affect or are affected by the digitalization in the L&SC industry (see Table 1) through the group discussions and the additional data from secondary sources. In the process, we also included the current frames of the respective actors and allocated an underlying logic to the actors. We restricted the underlying logics to what Thornton *et al.* (2012) define as so-called “core” logics that influence the behavior of actors, which includes the market, corporations, state, family, religion, community and profession. However, not all core logics can be applied in the context of the emergence and adoption of digitalization in L&SC, such as religion and family, and we restricted the underlying logics to state, corporation and market. Some of these core logics influence (or have influenced) the digitalization directly, while other have influenced indirectly. For example, states mostly influence the emergence and the adoption of digitalization indirectly through providing broadband capacity or the investment in faster Internet connections; thus, the state provides an underlying prerequisite without which digitalization cannot occur, but the state does not proactively encourage L&SC companies to implement more digital products and services. In the context of our research, which focuses on how digitalization

Key actor	Underlying logic	Framing in logistics context
L&SC companies	Corporation Market	Digitalization is a business case Use innovations outside of logistics further advance the company’s competitive advantage
Technology companies	Corporation	Use digitalization as a business model or use digitalization as foundation to build your business
Other industries	Market	Pioneer of the use of digitalization/trendsetter
	Corporation	Digitalization is a business case
Consumers	Market	Isomorphic behavior with regard to digitalization
	Market	Cheap (at least affordable) and fast access to products and transport
The European Union	States	Invest in digitalization but with strict regulation
The USA	State	Use digitalization for global competition
China	State	Use digitalization to become the global leader in technology
Rest of the World (ROW)	States	Use digitalization to participate in globalization
Logistics associations	Market	Innovations outside of logistics can be used to further advance logistics
Institutions developing international standards	Market	Digitalization needs to be regulated for a level-playing field

Table 1.
Key actors in L&SC digitalization

emerged and manifested itself in L&SC companies (firm level) and the L&SC industry (field level), the core logics of corporation and market are also heavily influencing the L&SC sector. In particular, a corporation logic would indicate an L&SC company embraces and pushes digitalization *internally* through new practices, products or services (e.g. Amazon), while a market logic would rather indicate that an L&SC company reacts to *external* market developments that increase digitalization levels (e.g. the adoption of radio-frequency identification [RFID]).

4.2 Key historical digitalization events in L&SC

As a second step, the group discussions identified the main historical events that have shaped and had an influence on the emergence and the adoption of digitalization in L&SC over the last 60 years. We used these examples to further explain and validate the frameshifts (see Figure 1).

4.3 Field-configuring events

With regard to key configuring events, the identification of the frameshifts from the group discussion and complementary secondary data allowed us to categorize these shifts into five overarching field frames (see Table 2), namely: *Field frame 1: the transformation from analog to digital services*, *Field frame 2: the dissemination of L&SC management software*, *Field frame 3: the globalization of supply chains through the World Wide Web and the Internet*, *Field frame 4: the rise of e-commerce* and *Field frame 5: the deployment of the Internet of Things and big data*. Below, we describe the key field frames along with the shifts and examples.

4.3.1 Field frame 1: the transformation from analog to digital services. The first frame that was identified in the group discussions represents the transformation from the use of analog technology to digital technology, leading to a gradual emergence of digitalization in the industry as well as in the L&SC but also in other industries, mainly in the USA. Similar to the development of “Industry 2.0” (Yin *et al.*, 2018), L&SC 2.0 emerged, which was characterized by computerized coordination processes between different participants in the same chain (Frazzon *et al.*, 2019).

During L&SC 2.0, EDI (i.e. structured electronic transmission of data between organizations) emerged, and the first EDI message were sent in 1965 using telex messages for trans-Atlantic shipping manifests between The Netherlands and the USA (McCarthy, 2013; Sheombar, 1992). Between 1965 and 1980, the development of EDI led to more paperless procedures, the introduction of electronic shipping documents and the use of terminal operating systems (Heilig *et al.*, 2017), thus displaying early signs of digitalized services. Through the increased use of EDI for international freight forwarding (Murphy and Daley, 1999), international agencies created several standards for exchanging data in trade documents like ISO 3535 and EDI Standard For Administration, Commerce and Trade covered by the norm ISO 9735 (Janssens, 2011). In addition, the automation of sorting and cargo handling become also popular in the 1970s with, e.g. increased use of automated sorting conveyor belts (Klump, 2018; Neradilová and Fedorko, 2016).

4.3.2 Field frame 2: the dissemination of L&SC management software. The business environment during the second frame was characterized by the emergence of the personal computer (PC). By 1981, IBM’s PC became a standard platform and business and government sectors were dominated by PCs (Ensmenger, 2012). Organizations, businesses and individuals increasingly used software solutions for daily operations, word-processing and accounting tasks, with Microsoft becoming the largest PC software company worldwide in the late 1980s (Campbell-Kelly, 2001; Dornberger *et al.*, 2018). The rise of PCs cannot only be viewed as a milestone for better computer access to planners and a new graphical environment for planning but led to a dissemination of flexible spreadsheets and map-based

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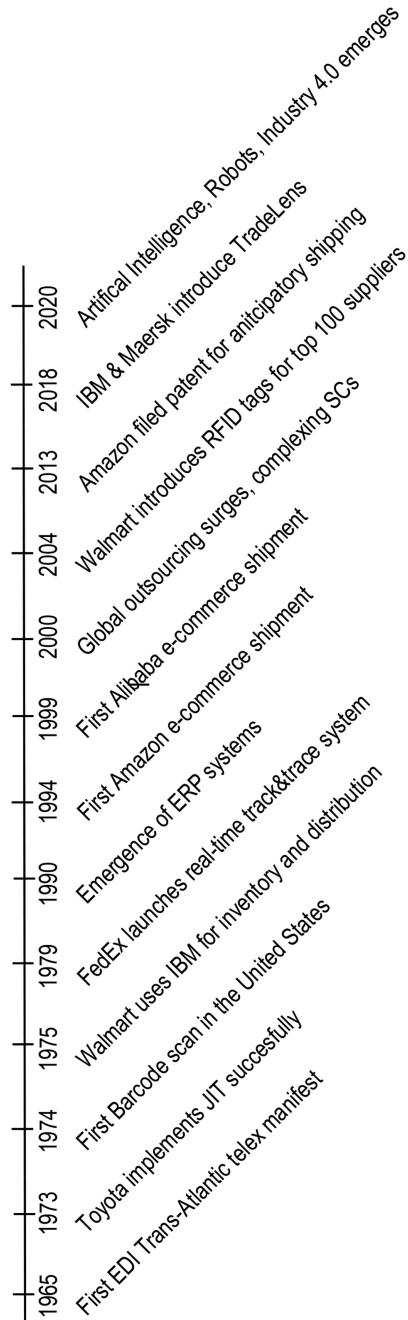


Figure 1.
Historical events of logistics and supply chain's digitalization

Year(s)	Event	Initial frame	New frame	Example	Outcome
<i>Field frame 1: the transformation from analog to digital services</i>					
1965–1990	1a	Shipping documents are based on manual and pure paper-based processes	Shipping information was sent through telex or electronic data interchange (EDI)	The first telex message (a forerunner of EDI) were sent in 1965 sending shipping manifests	Ports increased efficiency through the use of terminal operating systems, providing the foundation for the “globalization”
1965–1980	1b	Uncoordinated use of electronic exchange and technology	Development of standards for electronic interchange	Creation of IST standards such as for trade documents (ISO 3535) and administration, commerce and trade (ISO 9735)	EDI becomes more professional and standardized, leading to a further dissemination of EDI
<i>Field frame 2: the dissemination of L&SC management software</i>					
Early 1970–1980	2a	Traditional manufacturing was forecast driven	The introduction of the barcode shifts supply chains to demand-driven and drives efficiencies	In 1974, a pack of Wrigley’s chewing gum is the first retail product sold using a barcode scanner	Reduction in inventory levels and changes in supply chain structures
1970s–1980	2b	Warehouse and transportation management is not computer based	Supply chain management systems or material requirements planning (MRP) are introduced	Software programs (e.g. WMS) and/or automated storage and retrieval systems (AR/RS) were being deployed	Business drives the market by adopting integrated software solutions
Late 1980s–1990	2c	Logistics software restricted to one function, e.g. inventory	ERP programs go beyond one function and include, e.g. supplier materials and other functions	The automotive sector drives vertical integration with its suppliers and customers	Managers became aware of logistics as an area to significantly improve the bottom line
1970–1980	2d	Providing information is demand driven	Information is available in real time	FedEx Express launches the first digitized management system offering package status in real time	Investments in digitalization can lead to a competitive advantage
<i>Field frame 3: the globalization of supply chains through the World Wide Web</i>					
1985–2000	3a	Logistics transactions are rather one-way communications and information is often difficult to obtain	The Internet and the World Wide Web offer a two-communication approach and make it easier for organizations to obtain information	The simplified worldwide communication and real-time data flows leads to better information control and globalization	The worldwide information and data exchange with other countries push more complex supply chains

Table 2. Field frames of logistics and supply chain’s digitalization

(continued)

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Year(s)	Event	Initial frame	New frame	Example	Outcome
1990–2010	3b	Purchasing and logistics flows are restricted to rather local markets and global suppliers are hard to find	The Internet offers a two-communication approach, thus faster access to a worldwide market and global suppliers	In the 1990s, Walmart shifted their supply chain toward Asia for cheaper product purchase, leading to shift in power balance between discounters and US domestic suppliers	Easier controllable logistics flows lead to an increase in outsourcing and other alliances
<i>Field frame 4: the rise of e-commerce</i>					
1994–2010	4a	Shopping is dominated by brick-and-mortar stores = supply scarcity	Consumer increasingly order “online” = supply munificence	Amazon goes live in 1994 to deliver books within the USA from an online platform	Logistics activities gradually switch from B2B to B2C
1995–2005	4b	Database access is restricted to tightly controlled by a company	Cloud computing offers companies to combine various data flows	Cloud computing was popularized with Amazon.com releasing its Elastic Compute Cloud product in 2006	Cloud computing allows logistics companies to avoid or minimize up-front IT infrastructure costs
1995–2005	4c	Computer coordinates the supply chain	Platforms coordinate and create complex supply chains	Amazon creates an own complex digital ecosystem of consumers and suppliers	Data-driven platforms increasingly disrupt existing supply chains
<i>Field frame 5: the deployment of Internet of Things and big data</i>					
2015–today	5a	Applications are stand-alone solutions	Big data flows can be automated and thus provide	Alibaba introduced a patent for “anticipatory shipping”	Big data analytics further increase efficiency and reduce inventory costs
	5b	Internet applications are mainly isolated transactions/ stand-alone solutions	Collecting and connecting data enable new products and services	IBM and Maersk introduced blockchain to streamline customs and shipping processes	Information and data of consumer and transaction can be turned into a competitive advantage

Table 2.

interfaces which enabled huge improvements in L&SC planning and execution technology (Smith, 2003; Tyworth, 1991). For L&SC companies, the increase of computerization can also be linked to the rise of L&SC 3.0, known as “systems of logistics management” (Yavas and Ozkan-Ozen, 2020).

The participants highlighted in the group discussions that one of the first companies to recognize the value of supply chain planning and efficiency was Walmart in the USA. As one of the first retailers, Walmart leased not only an IBM computer system in 1975 to electronically control the inventory for its merchandise in their warehouses but also “Retail Link”, an early version of enterprise resource planning (ERP), to integrate its supply chain by providing vendors with relevant information such as sales or inventory levels (Lummus and Vokurka, 1999). As a consequence, ERP systems emerged in the L&SC environment not only to integrate multiple databases for efficiency purposes but also to improve data availability

and accuracy, leading to a recognition among managers and companies to better plan and integrate L&SC components (Robinson, 2007; Rutner *et al.*, 2003).

Digital innovations also emerged in the delivery industry, for example, to track packages, with FedEx Express launching the first digitized management system offering package status in real time in 1979, using early prototypes of handheld computers that could scan barcodes (Baldwin, 2013). The integration of databases also allowed an innovation that changed L&SC in manufacturing, the just-in-time (JIT) delivery, which was perfected by Toyota using technological advancements and gained increased attention in the 1980s, further stimulating digitalization efforts for L&SC (Lai and Cheng, 2016; Spencer *et al.*, 1994).

4.3.3 Field frame 3: the globalization of supply chains via the World Wide Web. The business environment in frame 3 is built around the introduction of the World Wide Web, making companies realize the enormous business potential through the Internet. Internet usage took off in the late 1990s and was widely adopted. Overall, participants described the significant impact of the Internet on information flows, which switched from analog to digital from only 1% in 1993 to 51% in 2000 and more than 97% in 2007 (Hilbert and López, 2011). The participants also agreed that the introduction of the World Wide Web and the Internet brought other field actors: the states, which was also confirmed by Drezner (2004). By upgrading capacity and communication lines, the state pursued mutual interests with corporations and the market, indicating a blending of state, corporation and market logics.

Through the Internet, global communication and coordination of L&SC “made the world smaller” (Levinson, 2016), and manufacturing companies were increasingly outsourcing parts of the supply chain to contract manufacturers, leading to rise of global trade routes (Cox, 1999; Mason *et al.*, 2002). In 2003, global trade represented for the first time more than 50% of the world’s gross domestic product (GDP) and was characterized by worldwide complex and multilayered supply chains (Kroes and Ghosh, 2010; World Bank, 2019). However, on the one part, the rise of outsourcing was also accompanied by the rise of logistics service providers (LSPs), which were considered as differentiator for a manufacturer’s competitive position (Ansari and Modarress, 2010; Li, 2011). On the other part, LSPs increasingly recognized the value of offering information technology (IT) and digital solutions to their clients and was also seen as a “competitive differentiator” (Lieb and Lieb, 2010; Razzaque and Sheng, 1998).

4.3.4 Field frame 4: the rise of e-commerce. The fourth frame comprises the impact and the rise of online shopping and technology companies, where in early stages, businesses saw e-commerce either as an opportunity or as a competition (Xu *et al.*, 2015). L&SC companies need to adapt to changing consumer behavior needs with changing business models (Cho *et al.*, 2008). At the beginning of e-commerce, actors in the field had competing views on how to deal with and react to e-commerce business models. However, the group discussions also highlighted that although the dot-com bubble and often unsustainable online shops collapsed in 2000, businesses recognized e-commerce as an opportunity and adapted their business models, which led to a rise in business-to-consumer (B2C) and business-to-business (B2B) shipments.

The rise of e-commerce can mainly be attributed to the company Amazon, which delivered its first book in 1994 but has since then shaped not only the online shopping experience but also the L&SC landscape (Wessel and Christensen, 2012). Amazon’s product – selling online and shipping – “changed the game” (Liebmann, 2013) and challenged brick-and-mortar stores through a new business model that was built around a facilitated network connecting worldwide suppliers and consumers (Christensen *et al.*, 2011; Wieland and Wallenburg, 2012). This network of suppliers and consumers using Amazon as a platform was also built around far-reaching L&SC that relied heavily on IT infrastructure to coordinate the digital

information flows. As such, Amazon can be regarded as a “pioneer” that was among the first to use “big data” as an opportunity to gain a competitive advantage (Wu and Lin, 2018), thus not only having adopted a digitalization logic but to further advance and manifest the technology for competitive reasons.

4.3.5 Field frame 5: the deployment of the Internet of Things and big data. The business environment in frame 5 relies heavily on digital products and services and the assumption that information and data of consumers and their transactions can be turned into a competitive advantage, further manifesting and expanding the digitalization logic in the field. More specifically, digitalization is characterized by interconnectivity, automation, machine learning and real-time data, which was also highlighted by the groups’ discussions. As such, the digitalization logic dominates combining physical production and operations with smart digital technology and big data to create a more holistic ecosystem for companies and state actors, the so-called Industry 4.0 which translates into L&SC 4.0, which led and is leading to a digital transformation within the L&SC industry (Tang and Veelenturf, 2019; Yavas and Ozkan-Ozen, 2020).

Companies increasingly see digitalization as an opportunity to transform L&SC. For example, in 2017, IBM and Maersk introduced blockchain technology to streamline global customs and shipping processes (Dobrovnik *et al.*, 2018; Groenfeldt, 2017; Kummer *et al.*, 2020). Studies and trials in the shipping industry predict enormous potential for growth and efficiencies through the use of artificial intelligence (AI) (Rozados and Tjahjono, 2014; Schrauf and Bertram, 2018; *The Economist*, 2019). AI can be used for predictive analytics in the shipping supply chain (Gunasekaran *et al.*, 2017) to, for example, the so-called anticipatory shipping which is used to “predict when a customer will make a purchase and begins shipping the product to the nearest hub before the customer places the orders online” (Lee, 2017, p. 593).

Given the ample opportunities for enhancements through digitalization in the L&SC industry, it is not a question whether L&SC companies should invest and adopt in process of digitalization, but rather who can use existing automated and digitalized products and services to further generate revenues or to build a competitive advantage. As a consequence, a digitalization logic in the L&SC industry has itself manifested as “digitalization is increasingly impacting the practice of SCM, to the point that SCM processes and activities in 2020 and beyond will no longer be recognizable vs the ingrained processes and activities that emerged from the 20th century/analogue age” (Stank *et al.*, 2019, p. 967).

4.4 The process of the emergence, adoption and manifestation of the digitalization logic

The construction of the field frames and its implications allows to draw conclusions how the digitalization logic in the L&SC industry has emerged on a firm level and manifested itself on the field level. In field frame 1, the emergence of digitalization in L&SC companies can be attributed to what Strang and Soule (1998) call “collective theorizing,” i.e. that several actors in the field were becoming aware that digitalization represents or may represent an opportunity for differentiation and thus is “emerging as a new tool to build and sustain [...] absolute advantages” (Bilbao-Osorio *et al.*, 2013, p. 42). In response to the inventions and innovations that served as key factors for a potential change for businesses, L&SC managers engaged in collective theorizing and broadened the scope of digitalization, also creating awareness about the issue and thus leading other actors to embrace the emergence of digitalization in L&SC companies.

In field frame 2, actors started to change their thinking about digitalization, and thus, a shift from the emergence of digitalization to a broader adoption could be observed. Driven by successes of Walmart’s supply chain innovations and the JIT delivery, managers increasingly invested in and adopted technologies to maintain or gain competitive advantages. As the FedEx founder Fred Smith were saying, “The information about the

package is as important as the package itself" (Baldwin, 2013), indicating that technology advancements can help to build a competitive advantage. As such, complementing the collective theorizing to embrace digitalization, actors in the field were also subject what Ansari *et al.* (2013) call "active learning," which occurs when "new information and evidence or changes in material and discursive conditions prompt actors to rethink the assumptions about the calculus of perceived gains and losses underpinning their logics" (p. 1,029). Managers learned that the adoption of new technologies and the use of digital products and services lead to better transparency and operational efficiencies, leading to a widespread adoption of digital management software and systems in L&SC.

Field frame 3 was characterized by the introduction of the Internet which can be considered a milestone for the advancement of L&SC companies, in particular with regard to outsourcing and the associated rise of LSPs (Sink and Langley, 1997). The increasing reliance of manufacturers and global operating companies on LSPs to handle complex and multilayered L&SC processes did not only lead to innovations to increase the efficiency within the L&SC sector but had far-reaching implications on power relations and power structures between nations and businesses. For L&SC companies, implementing and upgrading existing IT capabilities in order to participate in and gain from complex worldwide supply chain constructs "changed the game" and made digitalization a dominant and integral part of logistics. As such, it can be argued that with the introduction of the World Wide Web and the use of the Internet, L&SC companies permanently integrated digital products and services in organizational structures and business practices, thus adopted a digitalization logic.

We could observe in field frame 4, the key actors seek to benefit from digitalization, thus seeing a shift from adoption to manifestation of the digitalization. However, for L&SC companies, in particular for sea and rail, adapting their business model to incorporate the changes stemming from e-commerce was slow due to the reliance on old legacy information systems (Busse and Wallenburg, 2011; Economist, 2018; Fruth and Teuteberg, 2017). Our data suggest that although incumbent global L&SC companies have adopted a digitalization logic, their fragmented IT management systems and the associated decentralized IT approach made it difficult to catch up with the "new" technology companies such as Amazon and Alibaba which are built on new infrastructure and technology and can use richer and more visible L&SC data (Choudary *et al.*, 2019).

Field frame 5 represents "L&SC 4.0" (Winkelhaus and Grosse, 2020) or what Stank *et al.* (2019) call the "digitally dominated paradigm" for the L&SC industry, indicating a catalytic amplification in which "actions at lower levels shifted the calculus for higher-level actors" (Ansari *et al.*, 2013, p. 1,030), thus promoting a wider acceptance and a manifestation of a digitalization logic. Characterized by enhanced visibility, improved analytics and heightened operational flexibility and reduced cycle times, Stank *et al.* (2019) claim that digitalization will change L&SC and supply chain processes fundamentally and argue that "the digital world is here to stay" (p. 967). Our observations also suggest that from an institutional perspective, digitalization logic not only be adopted in L&SC but has itself manifested in organizational practices and structures. In other words, the digitalization logic has been "institutionalized" in L&SC organizations with the potential to further transform L&SC processes.

Figure 2 presents a summary and a timeline overview that depicts the process of the emergence, adoption and the manifestation of digitalization logic in the L&SC industry and other industries. In particular, the figure shows not only the development of digitalization from L&SC 2.0 to L&SC 4.0 but compares the digitalization process with the evolution from Industry 2.0 to Industry 4.0. Moreover, it depicts the role of actors in the process, i.e. it presents the key actors that were identified in Table 1, to demonstrate their impact between emergence and manifestation of the digitalization.

The emergence and adoption of digitalization

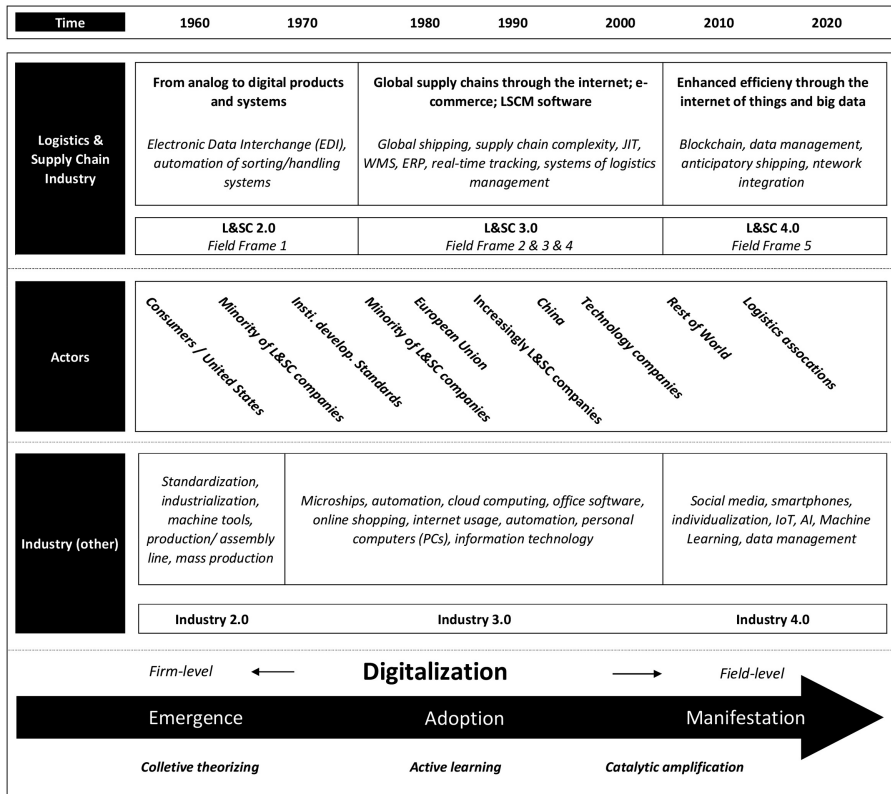


Figure 2. Digitalization logic: from the emergence to manifestation

5. Conclusion

Digitalization plays an increasingly strategic role in the L&SC industry; the ability to collect and analyze big data, improved visibility and connectivity of information in combination with a physical network with fast and reliable delivery options will have a significant impact on logistics productivity and supply chain networks. Deconstructing the emergence, adoption and the manifestation of digitalization in L&SC industry provides a broader understanding about institutional and industry processes and developments. With this study, we made three contributions: first, we showed how the digitalization logic has emerged, adopted and manifested itself in the L&SC industry. Drawing on institutional theory, which showed the emergence of the digitalization logic on a firm-level starting in 1960s to the manifestation on the field level in 2020, thereby advancing the institutional view on digitalization. In particular, we demonstrated how the interaction between different actors and logics led to institutional change and the process from L&SC 2.0 to L&SC 4.0. Second, we classified historical milestones and key configuring events in L&SC industry that have shaped the emergence and the adoption of the digitalization logic, thereby providing an overview about the key developments in L&SC. More specifically, the categorization of frames allowed us to identify how companies and actors revised their frames, leading to overarching field frameshifts that changed the perception of digitalization and eventually to the manifestation of a digitalization logic in L&SC. Third, we responding to calls to better understand, deconstruct or further advance the implications of digitalization on organization

and its processes and structures. Digital advances in today's industries are increasingly impacting the business, social and political environments within the L&SC industry. A better understanding how digitalization has emerged may offer insight into future developments and how companies and organization can react to these developments.

As such, our findings have relevant theoretical and managerial implications. From a theoretical perspective, our theorizing provides insight into the institutionalization of technological progress, which becomes more relevant in today's competitive L&SC environments. Although the adoption of digital products and services in different time frames and sometimes seem random, our study shows that the adoption and manifestation of digitalization in organizations is linked to large and complex sociotechnical system, the "institutional complexity" in which multiple logics are present at the firm and field level. Moreover, using institutional theory to investigate the emergence, adoption and manifestation of digitalization, this study offers an alternate to explain the mechanisms behind changes in actors' perceptions and frames' shifts as well as the diffusion of an institutional logic through a field. In other words, our study shows how field actors dealing with multiple logics not only create various frames but also how these actors revise their frames to reach consensus in the field.

From a managerial perspective, our findings can help managers in the L&SC industry to better understand the transformation of structures and practices that can change the "rules of the game." Although digitalization can be considered as a competitive advantage in the near-, middle- and long term, certain branches within the L&SC industry have not caught up yet and sometimes show little interest or efforts to drive digitalization in their companies or in their industry branch. For managers, our study not only shows the importance to enforce digitalization in the L&SC industry but also provides insight into the different adoption mechanisms and the associated actors that enact field-level changes, which can help to gain a better understanding how to implement digital practices in their company.

However, these findings need to be viewed in the light of their limitations. Although we are confident that the institutional view is the right approach to better understand the emergence, adaption and manifestation of the digitalization in L&SC, other theories may provide a different view and a more nuanced understanding. We are aware that this topic, covering the developments of over 60 years, is quite complex, and the digitalization within the L&SC industry may have also other influences and is shaped by different actors. The group discussion and the subsequent identification and consolidation of the milestones and frames is inherently subjective; thus, scholars may identify other key events and milestones that had an impact on digitalization in the L&SC industry. And although we have identified the frameshifts and identified how digitalization has established itself on the field level, developing a deeper understanding of "first mover" companies with regard to digitalization and their impact on the field level may also pose an opportunity for future researchers to further explore the link between firm- and field-level changes. Future research may also draw on our findings concerning the role of actors and their influence on digitalization in L&SC industry and compare or contrast our findings with other industries.

Research into digitalization, in particular in the history of digitalization, is still in its infancy. By investigating the emergence, adoption and manifestation of digitalization in the L&SC industry, we have taken the first step toward a better understanding of digitalization and its impact on businesses. We hope that both the findings and the discussions presented in this research will spark discussions and projects in the L&SC and digitalization sphere.

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