
This is an electronic reprint of the original article.
This reprint may differ from the original in pagination and typographic detail.

Paavola, Lauri; Cuthbertson, Richard

Algorithms Creating Paradoxes of Power: Explore, Exploit, Embed, Embalm

Published in:
Information Systems Management

DOI:
[10.1080/10580530.2021.1939200](https://doi.org/10.1080/10580530.2021.1939200)

Published: 01/01/2021

Document Version
Publisher's PDF, also known as Version of record

Published under the following license:
CC BY

Please cite the original version:
Paavola, L., & Cuthbertson, R. (2021). Algorithms Creating Paradoxes of Power: Explore, Exploit, Embed, Embalm. *Information Systems Management*, 38(4), 358-371. <https://doi.org/10.1080/10580530.2021.1939200>

This material is protected by copyright and other intellectual property rights, and duplication or sale of all or part of any of the repository collections is not permitted, except that material may be duplicated by you for your research use or educational purposes in electronic or print form. You must obtain permission for any other use. Electronic or print copies may not be offered, whether for sale or otherwise to anyone who is not an authorised user.



Algorithms Creating Paradoxes of Power: Explore, Exploit, Embed, Embalm

Lauri Paavola & Richard Cuthbertson

To cite this article: Lauri Paavola & Richard Cuthbertson (2021) Algorithms Creating Paradoxes of Power: Explore, Exploit, Embed, Embalm, Information Systems Management, 38:4, 358-371, DOI: [10.1080/10580530.2021.1939200](https://doi.org/10.1080/10580530.2021.1939200)

To link to this article: <https://doi.org/10.1080/10580530.2021.1939200>



© 2021 The Author(s). Published with license by Taylor & Francis Group, LLC.



Published online: 14 Jun 2021.



Submit your article to this journal [↗](#)



Article views: 696



View related articles [↗](#)



View Crossmark data [↗](#)

Algorithms Creating Paradoxes of Power: Explore, Exploit, Embed, Embalm

Lauri Paavola^{a,b} and Richard Cuthbertson^b

^aDepartment of Marketing, Aalto University, Helsinki, Finland; ^bSaïd Business School, University of Oxford, Oxford, UK

ABSTRACT

Algorithms play an increasing role in food retailing and distribution. Through a longitudinal study supported by qualitative interviews, we explore how such technologies have turned the sourcing of food into a highly automated transaction, moving from explore and exploit to embed and embalm. We demonstrate the impact that embedding algorithms can have on organizational processes and structures and that this may shift the balance of power within the value chain without being visible to management.

KEYWORDS

Algorithms; big data; power; Tesco; technology-in-use; coronavirus

Introduction

While food is obviously a vital human resource, the global Covid-19 pandemic has highlighted the reliance on technology in modern food and grocery distribution systems. Greater demand for eating at home, along with panic buying of certain critical products, led to short-term shortages highlighting the low level of grocery retail inventories and the dependency on anticipating demand in advance to activate the required just-in-time deliveries and relevant production schedules. Customer behavior altered so quickly that the automated retailer inventory and supply systems, based on algorithmic technologies, could not keep up with these changes in demand. Human intervention was required in many cases,¹ for example, by restricting access to popular goods. Meanwhile, demand for digital channels that enabled customers to avoid going to physical stores heavily increased and also had to be restricted.² It is worth noting that those grocery businesses least reliant on centralized, automated warehousing, including small local players, were the quickest to be able to expand their services.

Never-the-less, the use of algorithmic technologies and big data enjoys an ever-growing popularity among businesses, regulators, and scientists alike (McAfee & Brynjolfsson, 2012). As recently summarized by Introna (2016, p. 18), “computerized systems – often expressed as ‘algorithms’ or ‘code’ – seem to be organizing our lives and opportunities without our explicit participation, and seemingly outside of our direct control.” This trend is likely to continue as companies aim to better understand customers and anticipate their needs by relying on algorithmic inputs in their decision-

making processes (Davenport, 2013; Davenport & Redman, 2020; Etzion & Aragon-Correa, 2016). While the idea of capturing customers by measuring them is not a new phenomenon, the possibilities have grown due to recent advancements in how data can and is being processed (Chen et al., 2012).

In the context of food distribution systems, we have witnessed a shift in how food is made available to customers. Algorithmic technologies have radically transformed the practices of food retailers as explained by the following statement of a consultant in the grocery retailing field:

“Instead of retailers choosing their ranges from products available, the data started flowing to the opposite direction. The needs of customers are now reflected directly onto the suppliers and producers.”

In particular, the introduction of customer loyalty programs in the 1990 s and the growth of online retailing during the 2000 s has radically changed how data is being gathered and the type of data that companies can access. Whereas food retailers used to collect data on what consumers buy (“what products are sold”), they now collect data on how purchases are made by combining diffused and distributed data sets and by analyzing the interactions between purchasing behavior and other observable information. Collecting customer data at such a detailed level has become the norm since the British retailer Tesco introduced their customer loyalty program in 1995 (Humby et al., 2008; Paavola & Cuthbertson, 2018). The central idea of such programs is to organize food selling more effectively and to enhance customer experiences by responding to market demands (Pauler & Dick, 2006). Today, the way food

arrives into customers' shopping bags resembles a just-in-time endeavor, and data and information are the new "power" houses as argued in a recent *Food Logistics* article:

*"In today's omnichannel retail environment, consumer-focused retailers meticulously monitor everything from transactions and demographics to what people are saying in social media circles. Information is power. It is essential to survival."*³

In contrast to the attention that customer data attracts in practice as well as in marketing research, theorization and detailed empirical investigations focusing on how algorithms and big data have impacted the organizing of food distribution are rare. So far, research focused on the role of big data in retailing has revolved around questions as to how best to design customer loyalty programs in the light of profit maximization and effectiveness (Pauler & Dick, 2006), its impact on marketing practices and on consumer ethical concerns (Lacey & Sneath, 2006), well-being (Saarijärvi et al., 2016), and aspects of governance (Introna, 2016). Research on the organization of food systems more broadly has covered a variety of themes, for example, the increasing economization and financialization of the global food market (Clapp, 2016; Ghosh, 2010), changes in food consumption (Burch & Lawrence, 2007), and questions relating to labor and quality in food markets (Bonanno & Cavalcanti, 2012).

To better understand how the organizational aspects of food retailing, we study the introduction and diffusion of algorithmic technologies drawing on data from the UK food retail market. We are particularly interested in how algorithms have changed the nature of distribution – moving from a focus on products to a focus on customers, their behaviors, and the associated data analytics. Theoretically, we draw on a performative perspective of technologies and thus a practice-based understanding of the recursive interaction between people and technologies over time (Orlikowski, 2000, 2007). Studying the generative character of algorithms in the organizing of food systems, we explore how algorithms have built on the preferences of consumers, turning the sourcing of food into a highly automated transaction. Our paper, consequently, focuses on how algorithms are perceived and employed by food retailers and how this has changed the nature of food retailing in the UK over the last 40 years.

The paper's contribution is twofold. First, by considering the use of algorithmic technology in food retailing, we shed light on how algorithmic technologies change the way in which food supply is organized. Examining the agency power of algorithmic technologies in the

organizing of food distribution systems adds to our understanding of the generative and transformative nature of technologies (Barley, 1986; Orlikowski, 2007). This particular focus on big data and algorithmic technologies contributes to how such technologies are changing the way organizations function and it points to the challenges and opportunities that lie ahead of us (Constantiou & Kallinikos, 2015; Etzion & Aragon-Correa, 2016). Second, our study highlights the impact such transition has on how food is being viewed in our society. This adds to current research on how food markets have become increasingly driven by financial and economic considerations (Clapp, 2016; Ghosh, 2010).

The paper is structured as follows. The next section highlights the rise of big data and algorithms in organization studies and positions our research in the broader discussion of technology-in-use and its transformative power. After explaining the methodological choices that drove our data collection and analysis, we provide a chronological overview of customer loyalty programs and their associated data and algorithms in UK grocery retailing, before presenting the empirical findings of our study. We do so in the form of narratives and their interpretations that elaborate on the changes that food retailers have undergone and how the increased use of customer data has shifted the focus from (food) products to customers and the transformational impact of data and associated algorithms. This is followed by a discussion of whether it is clear who is driving decision-making – customers, technology, or management. To conclude, we reflect on how algorithmic technologies have led to the technologizing of food distribution and turned food into an automated transaction good. We conclude the paper by providing a set of key implications for future research as well as for practitioners.

Theoretical background

Algorithms and big data: origins and meaning

The origin of big data can be traced back to the 1940 s and the idea to quantify the growth rate in the volume of data as well as the growth of scientific knowledge. Following Gordon Moore's observation in 1965 that computer processing power was regularly doubling and Derek Price's (1961) "law of exponential increase" in data availability, discussions emerged not only on the limits of data storage capacity but also the limits of human capacity to absorb and make use of the increasing volume of data collected. The notion of big data then became prominent in the early 2000 s when computational capacities resulted in the development of many

new methods of data analysis (Varian, 2014). These new analytical methods together with the ever increasing amount of data available have led to a lively discussion in and beyond the social sciences on whether big data is the biggest innovation in computation in the last decade (Bryant et al., 2008).

Technically speaking, the term “big data” refers to technologies, systems, practices, methodologies, and applications related to the acquisition, storage, integration, analysis, and deployment of massive amounts of diverse data to support business decision-making (Chen et al., 2012; McAfee & Brynjolfsson, 2012). The switch from analog to digital data, coupled with better technology and the advancement in analytical methods, has triggered an evolution in measurement that is “as profound as what the microscope did to biology and medicine” (Chui, 2011) and provides competitive advantage to firms through enabling higher efficiency, productivity, and innovativeness. According to global CIO survey, customer service, marketing, and sales are the top drivers of big data initiatives, and half of all surveyed firms indicated customer-centric outcomes as their top priority. New algorithmic technologies “promise to unilaterally answer the two key questions that marketers have traditionally struggled with: how do I understand my customers better; and how do I get my personalized message to them?” (Hayward, 2016) As an answer, Hayward (2016) proposes that the ultimate solution lies in algorithms and technologies providing a seamless solution by offering ever more data about customers and ever more channels with which to reach them. Specifically, the combination of machine learning tools and the willingness of consumers to share personal information through different channels, generates customer insights that were previously not available (Nunan & Di Domenico, 2013). The analysis of finely grained data helps identify subtle trends and patterns in individual customer attitudes and behavior and enables firms to not only know their customers as a demographic segment but to understand them as individuals (Davenport & Redman, 2020).

From an organization studies perspective, big data and its underlying algorithms impact how organizations run and optimize their processes, do business, and secure their profits, as well as how they organize and manage. As summarized by Constantiou and Kallinikos (2015, p. 48), “the developments with which big data is associated establish a new and distinctive context for data generation and use” – moving from types of data to their usage (Abbasi et al., 2016). Accordingly, algorithmic and data-driven management challenges many assumptions by changing the relationships between organizations, their workers, their

customers and other stakeholders, as well as what is being organized.

While these relationships start to attract more scholarly attention, empirical research is still scarce and big data remains a practice driven phenomenon (George et al., 2014). Indeed, the existing research focuses on challenges that the use of big data creates. For example, Sivarajah et al. (2017) distinguish challenges related to the characteristics of the data, to the analytical processes, and to managerial decision-making. Apart from the question of how to make best use of algorithmic technologies and how they are changing business and society, several scholars stress the importance of big data in organization and management (George et al., 2014). One context where we see an increasing awareness of the potential of big data is in solving societal and environmental issues (Etzion & Aragon-Correa, 2016; Pasquale, 2015). This relates to our interests in the changes the organizing of food distribution has undergone and how food retailing has become algorithmic.

Algorithmic technologies-in-use

While the discussion about big data and algorithmic technologies is relatively new, questions about the role of technology in organizing are well-established (Leonardi & Barley, 2010). The mainstream view has been that technology is an exogenous factor that forms the basis for human activity, and ultimately for social change and, as such, technology has been conceptualized as a fact or defined entity. However, differing views have also shed light on the generative and transformative nature of technology. Most prominently, Science and Technology Studies (STS) have provided ample evidence that new technologies do not enter the world ready-made (Tuomi, 2002). Rather, they are interpreted and appropriated by relevant social actors within their specific context and within existing practices (Bijker et al., 1987).

The shift of attention toward social actors, and to what these actors do, has led to valuable insights. Orlikowski (2000), for example, shows how technology and actors change and adapt to each other in a reciprocal way. Using structuration theory, she recognizes the situativity and the role of agency in these mutual constitution processes (Giddens, 1984). Barley (1986) in his study on the engagement of different actors in two separate hospitals with CT scanning technology found that radiologists and technicians used the newly implemented technology differently, leading to distinct structuring dynamics and power relations. Following these accounts, several scholars have stressed the importance

of addressing technology without giving ontological priority to either social or material aspects and instead focusing on their entangled and performative nature (Orlikowski & Scott, 2008). In this view, non-human and human actors are considered mutually constitutive in their unfolding and thereby generative and transformational (Latour, 2005).

Currently we are witnessing how big data – as with so many technologies before – has the potential to change the way organizations function. We are still making sense of its consequences for organizing, and reorganizing, systems. The question remains open as to whether the use of algorithmic data is just the latest technology for which we can consider the consequences in the same way as previously or whether we need new theories and methodologies to approach the phenomenon. While this paper considers how our food systems have become algorithmic, big data is so pervasive that it is hard to grasp its full impact on society. Nevertheless, the use of big data seems to be the incorporation of what is meant by socio-material assemblages (Pickering, 1993).

The research question

Algorithmic technologies represent a challenge and opportunity to food retailers and other organizations alike. The increasing reliance on technology and data availability may appear in contrast to the mantra of consumer facing firms, such as food retailers, to continuously enhance the (human-centered) customer experience. The objective of this paper is to explore this encounter between food, data, and customers by studying how the introduction and use of algorithmic technologies is perceived by those responsible for its implementation and management within the food retail sector. Hence the question that this paper sets out to answer is: how do algorithmic technologies utilized in managing the encounter between food retailers, data, and customers change the way in which food supply is organized?

Methodology

Empirical context

In recent years, food has received increased attention in different disciplines ranging from sociology, for example, labor and food quality in the light of globalized markets (Bonanno & Cavalcanti, 2012) or current changes in food consumption (Burch & Lawrence, 2007), to economics, for example, focusing on the role of capital in transforming the food industry (Ghosh, 2010; Isakson, 2014), to environmental studies

interested in topics such as environmental change (Ericksen, 2008) or food waste (Stuart, 2009). Organization and management studies have far less embraced the topic despite the many paradoxes, problems, and potentialities associated with its organization. In this paper, we are particularly interested in the increasing use of algorithmic technologies in managing customer data by food retailers that has transformed the way in which food is organized. This change in practices has led to the creation of new processes, identities, and cultures on an organization-specific level and finally resulted in a wider field level transformation.

Although the shifting focus of an organization from products to customers is not a new phenomenon (e.g., Davenport, 2013; Davenport & Redman, 2020), the case of UK food retailing provides a particularly important empirical setting as it can be considered a frontrunner in this particular transformation. UK retailers have embraced technological change and can be considered one of the first areas for study where many decision-making processes have become entrenched in customer data analyses. As a result, the focus of food retailers and their suppliers has shifted at the field level from products to customers, with loyalty programs, electronic point of sales (EPOS) customer transactions, and online activities operating as vehicles for change. This transformation was underpinned by Tesco in 1995 when it launched its Clubcard (Humby et al., 2008; Paavola & Cuthbertson, 2018). The launch arguably provided Tesco with a valuable edge that was instrumental in steering the company into new profitable business areas, and forcing competing retailers to follow suit. After an exploratory phase during which computing power limited the use of data, the focus soon shifted to the exploitation of data, not only by the retailer, but throughout the supply-chain. These first two phases may be characterized as similar to Tushman and O'Reilly (1996) facets of an ambidextrous organization: i.e. “explore” and “exploit.” Following the definition by March (1991), exploration includes processes such as search, variation, risk taking, experimentation, flexibility, discovery and innovation, whereas exploitation focuses on processes of refinement, production, selection, implementation, and execution. Eventually, several data analyses became seamlessly automated by algorithms and were embedded as drivers of change within the organization, which could be defined as an “embed” phase. Over these three phases of development (“explore,” “exploit,” “embed”), retailers and suppliers have shifted their attention from islands of automation and data capture, such as sales tills, to a more integrated process of decision-making based on the overall customer experience, the so-called end-to-end journey from

processing the raw materials to sourcing the product to the consumption, taking into consideration customer service, the speed of the service, inventories, waste, and so on. Currently customer behavior is seen as the key driver of this development, with data being automatically collected and analyzed at every touch point (store, app, website, contact center, e-mail and social media) in ever greater volumes. Figure 1 provides an overview of this transformational change.

The chosen case setting can be considered extreme or polar in nature as the phenomena of interest are transparently observable relying on real-time documented publicly available data as well as interviews (Eisenhardt, 1989; Pettigrew, 1990). On the one hand, we can trace the broad transformational changes that the grocery retail sector went through over the last three decades; on the other hand, we have fine-grained knowledge about the organizations functioning in the sector throughout that time.

Empirical approach

For the purpose of creating a general understanding on the field-level changes in the UK grocery sector, extensive materials were collected and analyzed from public sources, such as newspapers, books, and annual reports, thus providing the background to this research. Building on this, the authors jointly conducted qualitative, semi-structured interviews with people working in the sector that provided the data for the purposes of this study. Overall, 13 interviews were conducted between years 2016 and 2017 with managers and senior executives from the major companies operating in the UK retail

market, with between 10 and 40 years of professional experience working with many firms within the sector. Secondary documentation, including internal reports and documents, were repeatedly consulted during the interviews to ensure their veracity. In choosing the interviewees, we particularly focused on informants who have been closely involved with the introduction of the use of customer data and its impact on the offer of goods and services across one or many of the major firms within the sector in order to ensure overall coverage across the whole of the sector. In addition to this, the selected interviewees had lived through all of the three identified phases during the studied transformation, namely “explore,” “exploit,” “embed.”

Since we were interested on how data has changed the processes, practices, and values related to food, a qualitative inductive approach seemed appropriate (Strauss & Corbin, 1998). We designed a list of semi-structured and open-ended interview themes that were used throughout the interviews conducted. The main themes related to customer data collection, analysis, and application at different phases of the development for each firm. We prompted our interviews to reflect on the meaning of customer data in their everyday professional life, how its use had changed their everyday routines, how it challenged the established identity and culture of their organizations, how this affected people and organizations to operate differently, and how customers reacted to it. The interviewees were asked to provide their views on the phases of change that the field and individual organizations have undergone, to explain and illustrate why and how the changes have happened, as well as to discuss the cause-and-effect relationships within the field. The interviews lasted between 30 minutes and 2 hours and resulted in approximately 14 hours

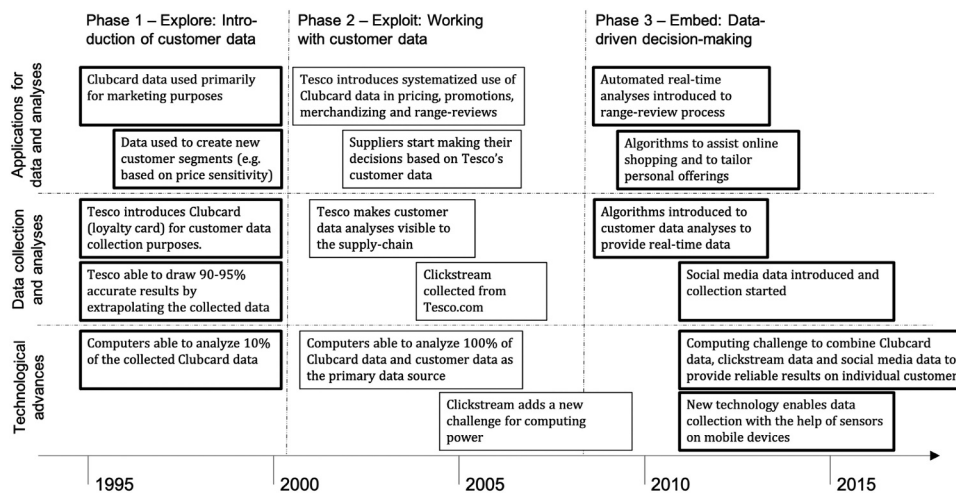


Figure 1. Overview of transformational change based on customer data management.

of interview material. All interviews were transcribed verbatim. Once we had completed the interviews, we compared them to each other, as well as with previously collected secondary data, and in cases of contradiction, sent the transcribed interviews back to the respondents for further clarification. The interviews provided a consistent picture and no major contradictions arose. We stopped the process after 13 interviews when no new insights emerged on our chosen topic for investigation and we considered saturation of our particular focus to have been achieved.

Analysis

We began our empirical analysis by thematic coding that enabled us to divide the past development into three distinct phases that were introduced earlier (see Figure 1). The initial coding was based on what was done with customer data (collection, analysis, and application), the scale of what was done (small scale experiments versus large scale production), and who the customer data was shared with (internally, such as marketing promotions, range reviews, and externally, such as suppliers and other parties). This was followed by a narrative analysis to provide further detail on the identified phases. In an iterative process during which both authors were involved, we analyzed the interviews individually and cross-checked our readings, going back and forth between theoretical concepts and empirical data. Thereby, the interview data guided our narrative analytical approach during which coherent as well as paradoxical narratives emerged. In broader terms, the thematic analysis identified what had happened, whereas the narrative analysis enabled us to focus on details of how and why. While we acknowledge that there are challenges in applying the same dataset for both approaches (e.g., McAllum et al., 2019), they are also jointly argued to produce a better multidimensional understanding of the observed phenomena (e.g., Floersch et al., 2010).

All of our interviewees emphasized the increased primary focus on customers, rather than products, in the development of food retail and supply organizations as well as stressed the importance of customer data as a tool for managing and developing how organizations adapt to the changing environment. Paradoxically, the interviews also implied that the increased technology focus has caused some organizational decisions to lose their visibility to senior leadership as it became embedded in operational technology and algorithms. Despite the fact that the data analytics were designed as a tool for management, it was no longer obvious who was driving decision-making – the embedded

algorithms or the individual managers. After identifying this paradox, we were able to further narrow down the scope of our analysis when investigating how the change has unfolded during the identified three phases: explore, exploit, embed. Our data does not necessarily represent a realist account but rather an inductive narrative based on how managers and senior executives have interpreted the change and envision the future.

From focusing on products to customers to data

We will now present how our different informants view the changes that the retail sector has gone through over the last 20 years, since the introduction of systematic tracking of customer data. Along the lines of the different phases of this transformation processes introduced in Figure 1, we focus on how people narrate and interpret the impact of algorithmic technologies on the organizing of food distribution. The final section of the findings focuses on how the increasing focus on data use and analysis creates a paradox of power leads to the question of “who is in charge?” – algorithms or managers?

Phase 1 – Explore: introducing customer data

In the mid-1990 s, grocery retailers in the UK started to rethink how they had collected and used customer data. The real starting point was when Tesco introduced its customer loyalty card (Clubcard). The idea was to gather information on who their customers were, and analyzing what they were doing, thus shifting the focus from product sales to who buys what, when, and where. This approach reflects one of Tesco’s core value: “No one tries harder for customers.” Before introducing customer cards and other means to track customers, the retailers had mainly looked at the sales and margins of products alongside factors such as distribution and weighted sales data in order to make decisions on what products to offer. Asked about how data was gathered back then, one interviewee answered:

“Typically, a branch manager would sit down and have a monthly meeting or whatever with their boss, the Regional Head of Operations. They would look at the P&L, they’d talk about sales, they’d talk about wastage, they’d talk about pay, which are the kind of elements on the profit and loss account [...] but never about customers, unless you count sales as a customer measure.” (L)

As another interviewee (J) summarized, 20 years after the introduction of the Clubcard, Tesco had about 83 million club members despite the fact that there are only about 65 million people living in the UK. Whereas

Tesco's focus lied very much on introducing and using its Clubcard, Waitrose started its data collection by introducing a large-scale customer survey called "Measuring the Magic." Historically focused on customer satisfaction and the in-store experience of customers, the survey replaced the long used "mystery shopping" approach. One manager summarized how the change impacted the scale and reach of the available data at Waitrose as follows:

"We would assess the customer service experience via one mystery shopper coming in once a month against a set of criteria. We paid those [few mystery shopper] customers, whereas now we are hearing from 30,000 customers a week." (A)

The customer survey is still today a crucial means to gather information from customers. To keep them motivated in participating and thus helping to improve the service, Waitrose offers its customers, who are members of their loyalty card program, free coffee and newspapers.⁴ Nevertheless, the response rates are currently suffering and Waitrose has therefore started to make more use of its customer card as well as other initiatives that rely on algorithmic technologies. Customers could for example, define ten products for which they get a twenty percent discount. If a customer never buys one of the chosen products, he or she would automatically be informed that it might be beneficial to change the personal picks including suggestions based on the shopping history.

We were particularly interested in what changes the move to algorithmic technologies has already entailed. What has been the reasoning behind this process? And how does the adoption of algorithmic technologies impact other work processes and practices within the organizations? Asked about what changed in how data is collected and analyzed, several interviewees gave very detailed accounts on how they gather information through the use of different technological tools and how this helps in better understanding customers. They explained how we can see the way "customers interact with the propositions" (C) made by the retailers, or how the customers react to new technological offers.

Enhancing customer experiences was an important factor in many initiatives that the interviewees talked about. However, in providing details about what was happening, many accounts remained focused on the activity of data collection and analysis experiencing some difficulty to link it to impacts on the practices of the organization at large or on how things are done in individual supermarkets. Instead, many interviewees deliberated about how the data is not yet used as much as it could be. The evidence from our interviews

illustrated that in some companies this might be due to the fact that the focus on data still seems to lie on how it is being gathered. In other companies, different algorithmic technology-driven initiatives seem to be deployed separately to one other, not yet allowing for a strong integration of the data analysis. One interviewee mentioned that he was "shocked at how few of these organizations really could explain the basic things they were trying to do" (C) and referred to how organizational silos prevented companies from gaining more insights from the data.

A third aspect that emerged from the interviews is that store managers reason differently compared to those managers working on the data analysis. The store managers often base their decisions on their prior experiences and their accumulated knowledge rather than specific data analysis. In some cases, their intuition proves right as in the example of arguing against the introduction of a pager for service counters that would buzz when your goods were ready. As one interviewee recapitulated the situation:

"It didn't prove successful. So we had customers say 'It didn't improve my experience' and store managers calling it 'clunky, adding an extra element to the process.'" (A)

While this particular technology was supposed to make the pick-up process leaner, it got more complicated and thus also more expensive at the end of the day.

In sum, companies had access to a large amount of data, and due to the increasingly available computing power and the knowledge on how to learn from the data, access to a pool of customer information that was out of reach until recently; or, as one of our interviewees who worked at Tesco in the late 1990 s explained, the computers available at the time could only process "0.5% of the barcode level data" (F). In this explore phase, the data analysis would either be a one-off analysis or would then have to be extrapolated to provide a general view on the behavior of customers and often was not shared across the organization.

Phase 2 – Exploit: working with customer data

As more detailed customer data became available and computational power increased, retailers were able to analyze a much larger amount of the data collected and to make inferences about previously hidden relationships. Based on the newly gained insights they began to develop so-called customer segmentation models, which were first based on geographic and demographic aspects and later also on behavioral variables. In a nutshell, these models divide customers into groups according to their needs and preferences. When first introduced, this was

a large shift from the product-based segmentation used up until then and it initiated a new era in which food retailers started to switch their data perspective from a product focus to a customer focus. Based on the new segmentation efforts, retailers would then develop products and services that were believed to enhance customer satisfaction. With time, retailers gained a more detailed and nuanced understanding of their customers; a trend that has been further enhanced by today's technological opportunities through which they were able to provide more and more customized offerings. As one interviewee said:

"The biggest change that came about with the growth of data [...], is that you're now able to much more effectively connect their behaviors and attitudes." (D)

Another interviewee emphasized that, while the available information on customers is definitely useful for the retailers as such, it becomes even more powerful when used by the various actors throughout the supply chain.

The initial development of this new type of collaboration can also be traced back to Tesco. The suppliers of Tesco became interested in the data that Tesco had and it was a turning point when retailers "start to try and get that data flowing through your supply chain" (M). One of the interviewees stressed that sharing the data very much changed the relationship between retailers and suppliers, which historically had been characterized by the leading question of "how cheaply" a retailer can buy a product and, on the other hand, how valuable if the supplier brand, which would enable the retailer to ask for a higher retail price. One interviewee reflected on the development in the following way:

"I think what some of the pioneers in this area realized was that, despite the fact that they're always going to negotiate on price, there was actually benefit in working together because at the end of the day, it was a combination of the efforts that delivered the customer experience." (M)

In 2002, Tesco made a deal to allow their data analytics company Dunnhumby to give anonymized access to analyses of their data to Fast-Moving-Consumer-Good (FMCG) companies. This enabled Tesco to work much closer with suppliers, such as Unilever, Procter & Gamble, Mars, and Heinz, and to develop a common understanding of "how they thought about their insights" (F).

Several interviewees suggested that working based on the same data and shared insights was most impactful when it came to "new product development and around ranging and assortment" (F). For example, when an item was sold to a customer, a data stream was created to inform replenishment and reorder functions. Sharing

data with suppliers thus helped in further integrating the production, the supply, and the sales functions, and made the influence of customer behavior more visible throughout the entire supply chain.

As we were interested in how this unfolded in practice and how it was beneficial for the retailers, we asked our interviewees to describe the particular use of these data streams. For example, at Sainsbury's most major suppliers now have access to customer behavioral data through joint ventures. While suppliers do pay for data access, the benefit comes from a joint analysis and interpretation of the same metrics in terms of sales performance, which enables retailers and suppliers to discuss ways to increase sales and revenues for the supplier and the retailer. To illustrate this relationship, one interviewee talked about promotions. For a very long time, retailers focused on promotions in ways that often led to substitution behavior by their customers. For example, if you have a special offer for Coke, you sell more Coke but less Pepsi. The customer might buy a bit more because they positively react to the deal, but in reality "the retailer sells the same amount of stuff" (M). Now, retailers are increasingly pushing their suppliers to design and fund promotions in such a way that these increase the total category sales rather than just the sales of a specific product at the expense of another.

Phase 3 – Embed: data-driven decision-making

According to our discussions with the different interviewees, the most recent advances in the use of data relate to the automation of the processes, such as collecting data and analyzing data. It seemed that the longer a retailer has worked with customer data in a systematic way, the more automated the processes became. While discussing the future direction in terms of data usage, one of our informants stressed that the services will and should be mainly embedded in algorithms:

"I think our viewpoint, my viewpoint, is that you should wherever possible be guided by how customers experience things rather than just how you happen to be set up." (F)

For him, algorithms that are customer-centric are the most reliable source for making decisions as they are based on customers' actions and not a store manager relying on her or his "gut feeling" as another interviewee referred to it (J).

Another trend that arose was the timeliness of the data. The majority of our interviewees emphasized the role of real time data. As everything needs to be done more efficiently, human agency is not considered to be the default way of providing this anymore. As explained: "in order for retail and supply chain analytics to work

effectively, companies need to have complete oversight over materials at every point in the supply chain” (field-note). To do this, businesses have leveraged automated data collection algorithms. This enables an organization to quickly and accurately determine where any given item is and divert it to the right location in real time according to customer needs.

One such example comes from online shopping. One of the interviewees explained that people often start an online shopping list days in advance and then they add more and more items up to the day of delivery. However, one problem that retailers face is that customers buying online only buy what is on their list, while those who take a shopping lists to a physical store buy more products than they have on their list. With the help of algorithmic technologies, retailers engaged in developing ways to help customers not to forget things when they shop online and to provide them with inputs and promotions similar to what they experience in stores as one interviewee explained:

“What we did was we analyzed people who made a big purchase online, and then within the next couple of days had been into a store to buy just one or two items with the idea that this would be an indication of the types of products that people might have forgotten.” (F)

Ultimately, the idea is to provide the customer with a single experience that integrates the advantages of physical and online shopping. At Tesco, this is today a small but appreciated service creating revenues and it is completely based on algorithms.

Another example is how retailers have recently developed analytic models that use weather data to properly stock store shelves. By looking at historical data on customer behavior and expected temperature trends, the business aims to accurately predict what customers in a specific region or area will want to purchase and then supply stores and locations accordingly. If warm weather is expected to come to an area after a particularly cold period, retailers will ensure that surrounding stores are well stocked with more barbecue meats and ice cream. Envisioning the future, retailers are currently exploring how to make more use of the available data. As discussed by Hayward (2016), even the “clever algorithms are still based on a very limited snapshot of the consumer – however big the data thinks it is, it will represent only a fraction of what could be known.” For example, phones have sensors that collect lots of data and that could in “theory be used to record customer data” (F). Or the fact that social media does not only give access to customer data but that customers are using social media in interacting with retailers. Certain customers “consider that if they tweet a dissatisfaction with Tesco” (F) it is the same as calling the helpline.

Discussion

“Who is in charge?” – a paradox of power

Despite the fact that all our interviewees agreed on the fact that the perspective shifted from focusing on product data to focusing on customer data, our analysis reflects two apparently competing narratives. Most managers stressed that the use of customer data was nothing but the logical consequence of the fundamental transformation when seeking to better manage customer experiences. Among these interviewees, it was primarily seen as a powerful tool for managers to improve their offerings. In this view, customers have increasingly been seen in the heart of all future development as described by Hayward (2016): “it has been proven many times that anyone can bribe a customer to change their behavior in the short term, but only truly customer-centric companies can create mutually rewarding, profitable relationships over the longer term.” To accomplish this, new technologies were seen as reliable and there was a big level of trust in the data. Accordingly, they felt that humans should have a marginal role in the analysis of the data and in their arguments the main driver for collecting the data was “to optimize the proposition based on customer data” (H). The focus of this narrative emphasized the role of technology in empowering management in doing the right thing for customers and the organization.

The counter-narrative focused on how the power and responsibility was shifted onto the customers as their decision-making became embedded in the algorithms. The belief was that not only did the customers’ actions become a central factor in what was being offered but that this was so unconscious and uncontrolled that it could lead to unexpected problems. One concern was that customer behavior and the reaction become so embedded in the data analysis process that it is no longer visible to managers (F). According to this counter-narrative, shoppers are no longer only end customers per se but instead algorithmic technologies have morphed them into co-decision makers who participate in production and supply decisions, without their power being transparent.

These paradoxes indicated that there is certain level of ambiguity on who is in charge of the system. For example, one of our interviewees stated that “a customer could never imagine what kind of process a single click online or a beep at the till will start” (field-note). In that sense, food supply becomes algorithmic to such an extent that those managers responsible are so focused on how to advance the analytical processes that technologies, rather than customers, are dominating their attention. One consultant talked about how retailers are so

taken by how to best analyze the data that they stop to ask more fundamental business-driven questions. The preservation of the relevance of the algorithms, and by implication the existing organizational processes and structures, become embalmed with promotional and other activity in order to save them from decay.

Technologizing food distribution

Food distribution has become increasingly automated requiring less and less human intervention. Algorithms have replaced human action patterns, changing the nature of their adaptation. Unlike routines conducted by humans, they now increasingly run the same way with every enactment (Powell & Rerup, 2018). Consequently, we have moved further and further away from food being considered as a valuable necessity of life, a source of nourishment, and a cultural feature of society (Anderson, 2014), and toward food as any other transaction that companies and their customers conduct. Again, the Covid-19 pandemic has dramatically reminded us of some fundamental truths: the necessity of food for human life.

However, the human processes related to the production of food are no longer the only, or even the primary, determinants of food distribution and consumption. As we have shown, the customer focus and algorithmic transactions throughout the supply chain have led to a situation where all products are expected to be available at all times. Accordingly, if the customer wants a product, it is shipped from any distance. Distances between production and consumption of food have increased as the global economy has grown. And it is not only the physical distance that has increased, but also the mental distances. Much has been written about the shopper being easily divorced from the methods of food production, but now the retail manager may also lack awareness of both production and distribution, who makes decisions and on what basis.

As food has become more transactional based, this has inevitably emphasized the financial aspects of food supply, increasing the vulnerability of certain countries and individuals (Clapp, 2016). Decision-making is increasingly being automated based on financial measures optimizing sales and profits. Such financialization of food has distanced producers from customers by stretching the scope of transaction between them (Ghosh, 2010). Therefore, it seems somewhat insufficient to analyze food sales, supply or production processes, patterns or problems in our quest to understand the societal paradoxes related to food. In contradiction, our narratives support the call to see production, distribution and consumption as integrally embedded.

With radical increases in computing power and the lowering of their associated costs leading to the advent of big data, algorithmic technologies around the collection and analysis of customer data have developed. Traditionally, retailers have designed their stores in particular ways, originally relying on store managers' and buyers "gut feelings" and then replenishing based on product sales. This has determined the offer available to customers and influenced their behavior. However, decision-making is increasingly automated, embedded in algorithms that operate based on customer data in real time, exceeding the efficiency of human agency. This is increasing as online retailing increases. This has amounted to a fundamental shift in the logic of decision-making in the field of retailing.

Our narratives indicate that technology, and algorithms in particular, have played a key role in this transformation of the field of food retailing and distribution. After the introduction of customer data analytics, computing power has developed immensely and enabled completely new ways of monitoring and organizing the firm. Whereas the initial challenge for firms related to the capacity of computing power and the ability to reliably extrapolate data in order to provide an overview of the market, the challenge today relates to combining vast amounts of data from a variety of data sources to understand an individual customer, and then to organize appropriately. During this same journey, data conceived for retail managers has been organized into a format for data-scientists and computers. As one of our interviewees explained: "Just because of the scale of it and the complexity . . . because it's not structured data, it's semi-structured data, you couldn't do it in Excel" (F). Consequently, information exchange has been technologized, and data has lost much of its managerial transparency. Algorithms now provide retailers and suppliers cheaper and faster means for responding to changing customer needs. As one of our interviewees explained in regard to home delivery services: "So we have algorithms that help try and free up the number of slots for grocery home delivery, we're trying to optimize things like making sure that I can get that delivery van to you in the quickest possible way" (J). Customer preferences have started being mediated through digital interfaces and algorithms, subtly restructuring and automating food offerings.

Focusing on how algorithmic technologies have changed the nature of food retailing enhances our understanding of the generativity of technologies (Barley, 1986; Orlikowski, 2007). While in many studies focusing on socio-material aspects of organizing we can see how humans and technologies are mutually constitutive, in this study technology seems to be

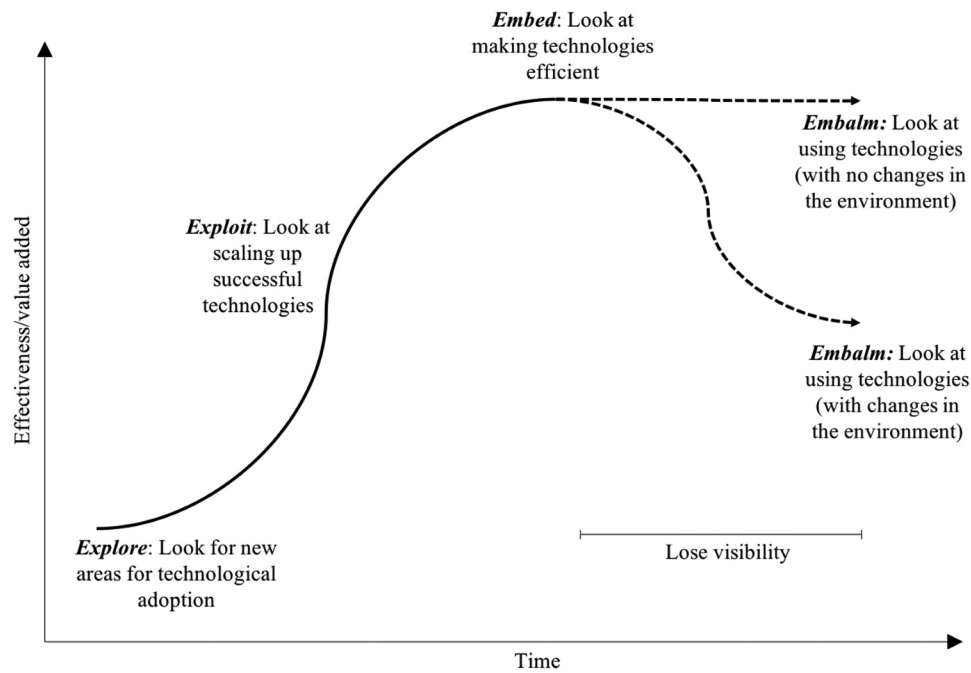


Figure 2. Changes in human-technological agency during technology development life cycle.

playing a major role in relegating human agencies to the boundaries. We have witnessed the move from “explore” to “exploit” to “embed.” Are we now moving to another stage? “Embalm,” which we define as preserving the primacy of algorithmic technologies in organizational processes and decision-making (see Figure 2). In our paper we have talked about the “socio-material aspects of organizing” as a move from a human led activity to a technology led activity. However, it seems that new human interventions (taking the development back to “explore”) are again needed to avoid embalming, one alternative being the renewal through the introduction of the next technology.

The Covid-19 pandemic has changed the environment and dramatically reminded us that algorithms are only as good as the data on which they are based. Customer behavior altered so quickly during the pandemic that the automated retailer inventory and supply systems, based on algorithmic technologies, could not keep up and short-term human intervention was required in many cases, for example, by restricting access to popular goods or channels.

Conclusions

Implications for future research

Our paper gives rise to a set of questions that may be useful for investigating the role of food under the

conditions of transparency, automation, and interaction with its environment, as well as the influence of technologizing in specific contexts.

In our narratives, we have observed a field-level transformation empowered by new technologies and the advent of big data. Despite the fact that the change has influenced every organization operating in the field of UK grocery retailing, the responses within the field have varied based on each retailer’s particular strategy and context. This has provided some organizations with a competitive advantage whilst it has also accrued costs. In order to understand the direction of technologizing of food in specific contexts, we need further interpretative inquiries into the mediation of technological innovations into practice, and how these mediations change in the process.

The main contribution of our paper is to add to this conversation by an illustration, where technology has actually shifted power and resulted in a situation where the balance of power is not always clear – whether the power is on those the data is collected from, on those who own the data, or hidden in the algorithms that mediate changes into action. Building on this, our study invites further reflection on technologies under the conditions of increased or decreased transparency. In the age of big data and algorithmic management, the nature of organizing is changing. Cases on the influence of technologizing and other interactions with organizations and their environments have traditionally considered data as a source of power for its owners. Our study

highlights the importance of understanding the dimension of power when implementing new technologies – algorithmic technologies in particular.

While doing this, we have also explored how algorithms have built on the preferences of customers while at the same time turned food from a valuable good predicated on supplier and retail buyer interactions into a more automated transaction. Literature has typically focused on how big data can lead to sustainable innovation (e.g., food waste, supply chain efficiency, etc.) and can thus be seen an opportunity. For example, Etzion and Aragon-Correa (2016) predict that sustainability reporting will become increasingly data driven, employing a wider array of real-time, data-rich entryways into exploring organizational sustainability performance. They argue that big data is likely to generate more opportunities to get more environmental and social data from firms and simultaneously to gain new opportunities. In contradiction to these overwhelmingly positive suggestions, our study illustrates that such transitions may also lead to rather contrary outcomes, where the technologies become embalmed, preserving the status quo rather than leading to further improvement. Therefore, we argue that there is a lot of space for further research to understand such transitions as well as the dimensions behind the surprising outcomes that may accrue.

Implications for practice

Academic literature promotes a transition toward digital in which data serves as a tool for making boundaries disappear (e.g., George et al., 2014; Introna, 2016; McAfee & Brynjolfsson, 2012). As described earlier, the tone of much academic literature seems to be strongly positive and mainly discusses the many new ways of creating efficiency and capturing value (e.g., Etzion & Aragon-Correa, 2016). It is often considered obvious that economic efficiency is increased when mediated by technology and algorithms (George et al., 2014). Our study serves as a reminder of the other side of the argument and suggests paying more attention to how data management is mediated and hence where does the balance of power lie? This shift has been accelerated more recently through technology supported human led activity in online shopping and the rise of social influencers (on social media). While technology plays a significant part in such mediation, it is just one variable influencing the outcome. In order to respond to changes over time, both radical and incremental, technology needs to be complemented by reflections on the human interventions and values that provide the boundary conditions for future development.

Notes

1. BBC news, “Coronavirus: What’s behind the great toilet roll grab?” by Lora Jones, March 26, 2020, see: <https://www.bbc.com/news/business-52040532>.
2. Financial Times, “US online grocery shopping jumps as chains rush to add capacity” by Dave Lee, June 1, 2020, see: <https://www.ft.com/content/029e3dab-78e6-4978-b73d-f00cd9877084>.
3. Food Logistics, “How Big Data is Changing Retail” by Scott Bolduc, April 8, 2015, see: <http://www.foodlogistics.com/blog/12062595/how-big-data-is-changing-retail>.
4. When spending £10 or more.

Acknowledgments

This paper builds on work previously presented by Lauri Paavola and Kathrin Sele at the 53rd Hawaii International Conference on System Sciences (HICSS-53), Maui, Hawaii, USA, Jan 7–10, 2020, published in the HICSS-53 Proceedings.

Notes on contributors

Lauri Paavola is a Postdoctoral researcher at the Aalto University School of Business and a Visiting academic at the Saïd Business School, University of Oxford. Lauri’s research focuses on organizational routines and the continuing importance of people and their interactions regardless of the many applications of technology within business.

Richard Cuthbertson is a Senior Research Fellow at the University of Oxford; Research Director of the Oxford Institute of Retail Management at the Saïd Business School, University of Oxford; and Fellow of Green Templeton College, Oxford.

Richard’s research focuses on the management of firms in a data rich world, where the diversity of customer experiences, formats, and channels combine to create a challenging environment for both business and public policy.

References

- Abbasi, A., Sarker, S., & Chiang, R. H. L. (2016). Big data research in information systems: Toward an inclusive research agenda. *Journal of the Association for Information Systems*, 17(2), 1–32. <https://doi.org/10.17705/1jais.00423>
- Anderson, E. N. (2014). *Everyone eats: Understanding food and culture*. New York University Press.
- Barley, S. R. (1986). Technology as an occasion for structuring: Evidence from observations of CT scanners and the social-order of radiology departments. *Administrative Science Quarterly*, 31(1), 78–108. <https://doi.org/10.2307/2392767>
- Bijker, W. E., Hughes, T. P., & Pinch, T. J. (1987). *The social construction of technological systems: New directions in the sociology and history of technology*. MIT Press.
- Bonanno, A., & Cavalcanti, J. S. B. (2012). Globalization, food quality and labor: The case of grape production in North-Eastern Brazil. *International Journal of Sociology of*

- Agriculture & Food*, 19(1), 37–55. <https://doi.org/10.48416/ijsaf.v19i1.235>
- Bryant, R., Katz, R. H., & Lazowska, E. D. (2008). Big-data computing: Creating revolutionary breakthroughs in commerce, science and society. *Computing Community Consortium*, 22(12), 1–8. https://cra.org/ccc/wp-content/uploads/sites/2/2015/05/Big_Data.pdf
- Burch, D., & Lawrence, G. (2007). *Supermarkets and agri-food supply chains: Transformations in the production and consumption of foods*. Edward Elgar.
- Chen, H. C., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *Mis Quarterly*, 36(4), 1165–1188. <https://doi.org/10.2307/41703503>
- Chui, M. (2011, October). Competing through data: Three experts offer their game plans. *McKinsey Quarterly*, 4, 37–45.
- Clapp, J. (2016). *Food, second edition*. Polity Press.
- Constantiou, I. D., & Kallinikos, J. (2015). New games, new rules: Big data and the changing context of strategy. *Journal of Information Technology*, 30(1), 44–57. <https://doi.org/10.1057/jit.2014.17>
- Davenport, T. H. (2013, October). Analytics 3.0. *Harvard Business Review*, 12: 64–72. <https://hbr.org/2013/12/analytics-30>
- Davenport, T. H., & Redman, T. C. (2020, May). *Digital transformation comes down to talent in 4 key areas*. Harvard Business Review. <https://hbsp.harvard.edu/product/H05N4Y-PDF-ENG?itemFindingMethod=Catalog>
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550. <https://doi.org/10.5465/amr.1989.4308385>
- Ericksen, P. J. (2008). Conceptualizing food systems for global environmental change research. *Global Environmental Change*, 18(1), 234–245. <https://doi.org/10.1016/j.gloenvcha.2007.09.002>
- Etzion, D., & Aragon-Correa, J. A. (2016). Big data, management, and sustainability: Strategic opportunities ahead. *Organization & Environment*, 29(2), 147–155. <https://doi.org/10.1177/1086026616650437>
- Floersch, J., Longhofer, J. L., Kranke, D., & Townsend, L. (2010). Integrating thematic, grounded theory and narrative analysis. *Qualitative Social Work*, 9(3), 407–425. <https://doi.org/10.1177/1473325010362330>
- George, G., Haas, M. R., & Pentland, A. (2014). Big data and management. *Academy of Management Journal*, 57(2), 321–326. <https://doi.org/10.5465/amj.2014.4002>
- Ghosh, J. (2010). The unnatural coupling: Food and global finance. *Journal of Agrarian Change*, 10(1), 72–86. <https://doi.org/10.1111/j.1471-0366.2009.00249.x>
- Giddens, A. (1984). *The constitution of society*. Polity Press.
- Hayward, M. (2016). Getting our finger back of the pulse. *Market Leader*, 1: 50–52.
- Humby, C., Hunt, T., & Phillips, T. (2008). *Scoring points: How tesco continues to win customer loyalty*. Kogan Page Publishers.
- Introna, L. D. (2016). Algorithms, governance, and governmentality: On governing academic writing. *Science, Technology and Human Values*, 41(1), 17–49. <https://doi.org/10.1177/0162243915587360>
- Isakson, S. R. (2014). Food and finance: The financial transformation of agro-food supply chains. *Journal of Peasant Studies*, 41(5), 749–775. <https://doi.org/10.1080/03066150.2013.874340>
- Lacey, R., & Sneath, J. Z. (2006). Customer loyalty programs: Are they fair to consumers? *Journal of Consumer Marketing*, 23(7), 458–464. <https://doi.org/10.1108/07363760610713000>
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.
- Leonardi, P. M., & Barley, S. R. (2010). What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing. *Academy of Management Annals*, 4(1), 1–51. <https://doi.org/10.5465/19416521003654160>
- March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71–87. <https://doi.org/10.1287/orsc.2.1.71>
- McAfee, A., & Brynjolfsson, E. (2012). Big data: The management revolution. *Harvard Business Review*, 90(10), 60–66. <https://hbr.org/2012/10/big-data-the-management-revolution>
- McAllum, K., Fox, S., Simpson, M., & Unson, C. (2019). A comparative tale of two methods: How thematic and narrative analyses author the data story differently. *Communication Research and Practice*, 5(4), 358–375. <https://doi.org/10.1080/22041451.2019.1677068>
- Moore, G. E. (1965). Cramming more components onto integrated circuits. *Electronics Magazine*, 38(8), 114–117.
- Nunan, D., & Di Domenico, M. (2013). Market research and the ethics of big data. *International Journal of Market Research*, 55(4), 505–520. <https://doi.org/10.2501/IJMR-2013-015>
- Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11(4), 404–428. <https://doi.org/10.1287/orsc.11.4.404.14600>
- Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies*, 28(9), 1435–1448. <https://doi.org/10.1177/0170840607081138>
- Orlikowski, W. J., & Scott, S. V. (2008). Sociomateriality: Challenging the separation of technology, work and organization. *Academy of Management Annals*, 2(1), 433–474. <https://doi.org/10.5465/19416520802211644>
- Paavola, L. J., & Cuthbertson, R. W. (2018). Routines as drivers of adaptation, incremental change and transformation. *Academy of Management Proceedings*, (2018(1), 15686. <https://doi.org/10.5465/AMBPP.2018.15686abstract>
- Pasquale, F. (2015). *The black box society: The secret algorithms that control money and information*. Harvard University Press.
- Pauler, G., & Dick, A. (2006). Maximizing profit of a food retailing chain by targeting and promoting valuable customers using loyalty card and scanner data. *European Journal of Operations Research*, 174(2), 1260–1280. <https://doi.org/10.1016/j.ejor.2005.03.028>
- Pettigrew, A. M. (1990). Longitudinal field research on change: Theory and practice. *Organization Science*, 1(3), 267–292. <https://doi.org/10.1287/orsc.1.3.267>
- Pickering, A. (1993). The mangle of practice: Agency and emergence in the sociology of science. *American Journal of Sociology*, 99(3), 559–589. <https://doi.org/10.1086/230316>
- Powell, W., & Rerup, C. (2018). *Opening the black box: The Microfoundations of Institutions*. The SAGE handbook of organizational institutionalism (2nd ed.). Sage Publications.
- Price, D. J. (1961). *Science since Babylon*. Yale University Press.

- Saarijärvi, H., Kuusela, H., Kannan, P. K., Kulkarni, G., & Rintamäki, T. (2016). Unlocking the transformative potential of customer data in retailing. *The International Review of Retail, Distribution and Consumer Research*, 26(3), 225–241. <https://doi.org/10.1080/09593969.2015.1105846>
- Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of big data challenges and analytical methods. *Journal of Business Research*, 70(C), 263–286. <https://doi.org/10.1016/j.jbusres.2016.08.001>
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Sage.
- Stuart, T. (2009). *Waste: Uncovering the global food scandal*. W.W. Norton & Co.
- Tuomi, I. (2002). *Networks of innovation: Change and meaning in the age of the internet*. Oxford University Press.
- Tushman, M. L., & O'Reilly, C. A. (1996). The ambidextrous organization: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 1–23. <https://doi.org/10.2307/41165852>
- Varian, H. R. (2014). Big data: New tricks for econometrics. *The Journal of Economic Perspectives*, 28(2), 3–27. <https://doi.org/10.1257/jep.28.2.3>