ORGANIZATIONS AS ALGORITHMS:
A NEW METAPHOR FOR ADVANCING MANAGEMENT THEORY

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'Counterpoint' perspective in the 'Point-Counterpoint' exchange about

What is the future of management theory
in the era of big data and algorithmic decision-making?

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ABSTRACT

According to the 'Point' essay, management research's reliance on corporate data threatens to replace objective theory with profit-biased 'corporate empiricism,' undermining the scientific and ethical integrity of the field. In this 'Counterpoint' essay, we offer a more expansive understanding of big data and algorithmic processing and, by extension, see promising applications to management theory. Specifically, we propose a novel management metaphor: organizations as algorithms. This metaphor offers three insights for developing innovative, relevant, and grounded organization theory. First, agency is distributed in assemblages rather than being solely attributed to individuals, algorithms, or data. Second, machine-readability serves as the immutable and mobile base for organizing and decision-making. Third, prompting and programming transform the role of professional expertise and organizational relationships with technologies. Contrary to the 'Point' essay, we see no theoretical 'end' in sight; the organization as algorithm metaphor enables scholars to build innovative theories that account for the intricacies of algorithmic decision-making.

New metaphors are capable of creating new understandings and, therefore, new realities.
-- Lakoff and Johnson (1980, p. 235)

According to the 'Point' essay, the corporate stronghold over data and its processing mechanisms poses significant challenges to the future of management theory. When theorists mine data from these corporate repositories, they may inadvertently tread on thin theoretical ice owing to distortions introduced by scaling and proxy effects. However, such outcomes are hardly inevitable. Far from finding themselves at the mercy of corporate data and its processing techniques, theorists have at their disposal robust options for reimagining such data.

Our optimism derives from insights derived from our introduction of a novel management metaphor (Cornelissen, 2017; Putnam et al., 2017), which conceives of organizations as algorithms. In place of the rigid and fatalist interpretation offered in the 'Point' essay, our metaphor views organizations as dynamic assemblages (Gehman et al., 2022; Glaser, Pollock, et al., 2021), constructed of four fundamental components: data, algorithms, decisions, and routines (Glaser, Valadao, et al., 2021). We suggest that this ensemble undergoes constant assembly and reassembly, taking forms that are sometimes structured like trees (arborescent), at other times sprawling like roots (rhizomatic), or even a hybrid of both (Gehman et al., 2022).

From the organization as algorithm metaphor, we enumerate three key insights. First, we challenge the traditional dichotomy in management research that sees agency as residing solely in humans or algorithms (e.g., Murray et al., 2021). We advocate for a paradigm shift, placing the assemblage as the epicenter of agency. This reconceptualization de-centers humans, data, and algorithms, presenting a more holistic understanding of the interdependencies that define our organizational landscapes. Second, our metaphor transcends the conversation about the politics of categorization and data (e.g., Bowker and Star, 2000; Kennedy & Phillips, 2023; Zuboff,

2019). We acknowledge the immutable and mobile foundation (Latour, 1987) of algorithmic organizing and decision-making: machine-readability. This aspect offers a fertile ground for developing theories that grapple with the fluid nature of information and its processing in organizational contexts. Third, our metaphor highlights how the dynamics of prompting and programming are not only altering professional expertise but also transforming organizational relationships with technology (e.g., Anthony et al., 2023; Kellogg et al., 2020; Pakarinen and Huising, forthcoming; Waardenburg, Huysman & Sergeeva, 2021). This insight nudges us to rethink established theoretical conversations around professions, routines, capabilities, identity, and so on.

In sum, by envisioning organizations as algorithms, scholars can elide the grim outlook presented by the 'Point' essay, while provoking opportunities for innovative and relevant theorizing in an age increasingly characterized by algorithmic decision-making.

ALGORITHMIC DECISION-MAKING AND THE FUTURE OF MANAGEMENT THEORY

Management scholars are increasingly using sophisticated algorithms to gather, analyze, generate, and substantiate insights from data, which in turn shapes both their understanding of organizations and the theoretical frameworks that seek to explain them. For the 'Point' position, this advent raises some key concerns. Lindebaum, Moser, and Islam underscore several challenges big data and algorithmic decision-making (ADM) introduce to theory-building processes, particularly the impact of corporate empiricism and the growing trend of management researchers sourcing data from profit-driven corporate entities, such as Google, Facebook, Microsoft, and so on. This reliance, they argue, jeopardizes the very foundation of scientific

theorizing. In their conceptions, theories crafted or tested on such data risk being skewed by corporate objectives, thereby distorting scientific validity due to scaling effects, proxy measures, and profit-oriented ADM. Additionally, the 'Point' perspective warns that if corporate interests subsume the social sciences' dedication to the public good, this could weaken the accountability mechanisms that undergird academic integrity and, ultimately, erode public trust in research. Therefore, they call for a critical examination of data sources and methodologies in management research to preserve scholarly credibility.

Here, we agree that preserving scholarly credibility is key—and that corporate empiricism produces important effects on theorizing processes, outputs, and optics that need to be accounted for and taken seriously. However, we argue that the 'Point' perspective assumes an overly rigid perspective on corporate ADM, assuming that management scholars' only recourse is a Procrustean one: to force existing theoretical constructs onto new digital measures even when they fail to fit. We suggest that this is not a deterministic, preordained outcome for management theory: it overlooks how management theorists might proactively harness the advent of algorithmic decision-making not just for theory adaptation but for pioneering entirely new theoretical paradigms. What we add, stated simply, is this: the measurements and constructs used by corporations and by theorists are components of broader algorithmic assemblages, and should be understood as such.

As an example, one could bemoan the fact that "number of friends on Facebook" does not operationalize a nuanced concept like friendship (Lindebaum, Glaser, et al., 2022), or one could see this proxy as an interesting phenomena in its own right – as part of a broader assemblage that invites several lines of inquiry. For instance, what meanings are ascribed to one's number of friends, when, and why? How does Meta use such data, and how have these

uses changed over time, whether inside or outside Meta's changing boundaries? How could "number of friends on Facebook" be used within social science research? Recognizing that agency emerges from the interplay within assemblages—which include data, algorithms, routines, and decisions—we understand that it does not belong solely to any single component or individual (Deleuze and Guattari, 1987; Glaser, Valadao, et al., 2021).

More generally, proxies represent a vital challenge for social sciences: the need to reinterpret social behaviors in light of the patterns and scales revealed by digital data, potentially requiring a significant rethinking of sociological methods and the development of new ways to represent and understand social data (Beer and Burrows, 2007; Savage and Burrows, 2007). Burrows and Savage (2014) have argued that the proliferation of transactional data from global acts of 'prosumption' (production and consumption) has transformed both the landscape and implications of sociological research. They note the entwinement between social science research and privatized data sources and point out how digitized data access can complicate the research process by allowing for analyses that may bypass the constraints of more conventional research methods. Amid this, they call for scholars to engage with big data, its sources, and associated processing techniques to ensure theorists maintain a strong voice in shaping the emerging conception of social knowledge. In sum, the 'Point' perspective underestimates the ability—and the responsibility—management scholars have to create new theoretical constructs that are appropriate for the new types of digital data that have emerged in the era of ADM.

Building on these thoughts, we posit that management theory can be substantially enhanced in the era of algorithmic decision-making by the introduction of a new perspective. Specifically, we propose that invoking the metaphor of 'organizations as algorithms' can engender the conception of fresh theoretical perspectives (Cornelissen, 2017; Lakoff and

Johnson, 1980; Putnam et al., 2017) that connect with the intricacies of modern, data-rich organizational environments. In this light, our metaphor becomes a rich vein of inquiry, inviting us to reconsider organizational structures, power dynamics, and decision processes, thus opening space for theorizing that encapsulates the complexity and adaptability of contemporary organizational life.

ORGANIZATIONS AS ALGORITHMS

Existing Metaphors in Organizational Theory

In *Images of Organization*, Morgan (2006, p. 5) posited that "all theory is metaphor," as it implies a particular perspective and influences how we perceive the world around us. On this account, the choice of a metaphor has profound influences—both positive and negative—on our thinking and vision. Because no single theory or perspective provides an all-encompassing view of reality, the skillful use of metaphor can cultivate new ways of seeing, understanding, and managing situations. Taking seriously the notion that organizing is a creative process of "imaginization," Morgan asserted that it is possible to "imaginize" in novel ways (p. 365), and highlighted three metaphors that have hitherto inspired a large portion of management theory: organizations as machines, organizations as organisms, and organizations as brains.

When viewed as machines, organizations are conceptualized as interconnected and interdependent parts aiming to achieve specific goals, as exemplified by the assembly line approach of fast-food chains which Ritzer (2007) dubbed "McDonaldization." This mechanistic perspective—supported by Weber's bureaucratic ideals (1958) and other classical management theories (e.g., Taylor, 1911)—emphasizes efficiency, predictability, and control through hierarchical structures and detailed regulations, aiming to guide organizational activity towards efficient ends. Such mechanistic approaches excel in stable environments where tasks are

straightforward, rules and regulations can govern, and precision is essential. However, they falter where adaptability is crucial, often promoting blind adherence to norms and squelching innovation, treating employees as interchangeable parts and risking high failure rates. Lindebaum, Vesa, and den Hond (2020) critique this extreme mechanistic metaphor, arguing that AI algorithms might amplify such rationality, suppressing substantive rationality and choice, potentially mechanizing values in the process (Lindebaum et al., 2023) and evoking Weber's (1958) imagery of a hyper-bureaucratized organizational life.

The "organizations as organisms" metaphor emphasizes an organization's relation to broader environmental systems, focusing on survival, adaptability, and organizational "health" rather than the narrow goals and structures characteristic of the machine metaphor (Morgan, 2006, p. 39). This perspective, embodying concepts like organizations as open systems (Lawrence and Lorsch, 1967) and species (Hannan and Freeman, 1977), urges a study of how organizations interact with and adapt to varying ecologies, and has influenced theories in organizational psychology and population ecology, exploring diverse organizational adaptations and developments. In this conception, organizations need to continuously assess and align with environmental needs to thrive (Morgan, 2006). However, this metaphor has its limitations. First, it obscures the concept that organizations are products of human creativity rather than natural to their environment, and similarly "human beings, in principle, have a large measure of influence and choice over what their world can be" (Morgan, 2006, p. 69). As such, this metaphor underplays an organization's ability to create resources and entire ecologies that did not previously exist. Second, the functional unity assumed by this metaphor—that all parts of an organization selflessly work for the good of the whole—negates the clashes and conflicts that often arise in organizational life.

Using the metaphor of a brain, organizations are conceptualized as vibrant systems that process information, communicate, make decisions, and evolve through experience. Such organizations, inspired by the "learning organization" model, offer the adaptability and malleability seen in the human brain, enabling distributed intelligence, control, and self-organizing capabilities (Morgan, 2006, p.72). This concept has roots in theories from the Carnegie School (e.g., March and Simon, 1958) and cybernetics (e.g., Wiener, 1961), emphasizing an organization's ability to make decisions, self-regulate using negative feedback, and shift from conventional single-loop learning to the more transformative double-loop learning (see Morgan, 2006, p. 85 for a diagram). The idea further develops into visualizing organizations as holographic, where every fragment reflects the whole, diffusing and decentralizing control while promoting continuous adaptation (Morgan, 2006). Recently, Csaszar and Steinberger (2022) show how artificial intelligence research related to the themes of search, representation, and aggregation have inspired dozens of contributions to organization theory. Though the prospect of a perpetually evolving, learning organization is attractive, varied conceptualizations of brain functionalities cast doubts on the metaphor's clarity and usefulness (Morgan, 2006). Additionally, this metaphor obscures the inherent tensions between learning and self-organization, and between power and control, raising questions around whether and how organizations spontaneously acquire essential knowledge and skill to navigate the complexities involved in interpreting pertinent information.

Limitations of Existing Metaphors

Although these metaphors have engendered many useful theoretical insights, they feature characteristics that limit their ability to help scholars generate new theory in the age of

algorithmic organizing and decision-making. First, all three metaphors conceptualize organizations as distinct from their environment, with either the environment or the organization privileged as a focal unit of analysis. This is particularly relevant in the age of algorithmic decision-making, because organizations and their environments are algorithmically co-constituted (Omidvar et al., 2023). Thus, the distinction between organization and environment is itself algorithmically located. Second, these perspectives offer a bifurcated view of agency, privileging either organizational or environmental factors. With algorithmic decision-making, it becomes particularly difficult and tricky to unpack who is responsible for what, as observed by scholars who have explored the ethical implications of algorithmic decision-making (e.g., Martin, 2015, 2019; Metz, 2023). Third, existing metaphors fail to account for the deep technological and material infrastructure that facilitates algorithmic decision-making (e.g., Orlikowski, 2007; Orlikowski and Scott, 2016). Algorithmic decision-making involves intricate and entangled connections between data, its computational analysis and processing, and related organizational activities.

One of the reasons the 'Point' essay sees a dismal future is because its arguments trip over these shortcomings. First, the 'Point' paper perceives data as a standalone agent, arguably distinct from the theorists who use them and from the algorithms that process them. Privileging data as the focal unit of analysis is problematic because data exists as only one part of the theorizing assemblage. The "corporatization of data" need not be intrinsically problematic; when understood in context, "corporatization" can be accounted for in the research design or become a subject of investigation in its own right. Second, by focusing on the roles of data, proxies, scaling, and the performativity of data, the 'Point' paper neglects the interconnected and multiple assemblages involved in theory construction and dissemination. We suggest that understanding

these interactions fosters a more interconnected and flexible approach to theorizing that can lead to the "lines of flight" necessary to discover truly novel theoretic and methodological insights (Deleuze and Guattari, 1987, pp. 12–14). Third, by locating the core threat to management theory's future in the corporatization of data, the 'Point' perspective fails to acknowledge that theorizing is at its core an exercise in imagination (Morgan, 1980; Weick, 1989). Data—their varied sources and uses, the varied ways by which they are processed, and the many checks and balances necessary to validate findings—may all be grist for the process of theorizing, but data should not be mistaken for theory (Weick, 1995). To address these limitations, we introduce a new metaphor: *organizations as algorithms* (see Table 1 for a comparison of metaphorical perspectives on organization).

-- Insert Table 1 about here --

A New Metaphor to Advance Management Theory

The conceptual metaphor of organizations as algorithms reshapes our understanding of agency, decision-making, and organizational structures within networked economies in three significant ways. First, it posits that agency is an assembly (Deleuze and Guattari, 1987) that is dispersed across a network of socio-technical arrangements, encompassing discourse, procedures, and technologies that collectively facilitate action, thereby challenging traditional notions of accountability (Callon, 2008). Second, this perspective reveals the intricacy of algorithmic decision-making through the interaction of diverse assemblages—combinations of data, decisions, routines, and actants—necessitating a detailed exploration of their relational and sociomaterial intricacies (D'Adderio et al., 2019; Glaser, Pollock et al., 2021). Third, it introduces the dichotomy of arborescent and rhizomatic structures in assembling agency, where the former denotes hierarchical connections and the latter symbolizes a non-hierarchical network

connecting disparate points (Gehman et al., 2022), thus offering new theoretical tools for analyzing the multiple ways that organizations and environments intertwine, how assemblages organize even amid flux, and how the mechanisms and modes of data capture and processing unfold within organizational life. These insights inspire our metaphorical insights that management scholars can apply to generate innovative, relevant, and grounded theory.

Insight #1: Agency Resides in Assemblages—Not Humans, Algorithms, or Data

Viewing organizations as algorithms reveals that agency exists in assemblages, not just in humans or artifacts, and counters the idea that algorithms are simply the latest hammer—mere tools for achieving strategic goals (e.g., Davenport, 2018; McAfee and Brynjolfsson, 2012; Schildt, 2020). Other research presents a more nuanced view of agency, highlighting the complex and often destructive effects of algorithmic control. For instance, Moradi and Levy (2020, p. 270) observed that AI-driven tools increasingly "reallocate risks from [firms] to workers." Kellogg et al. (2020, p. 366) explicated further, suggesting that algorithmic technologies enable "managers [to] implement new production technologies and control mechanisms that maximize the value created by workers' labor" while "workers, in turn, resist and defend their autonomy in the face of tighter employer control." Similarly, Curchod, Patriotta, Cohen, and Neysen (2020) found that technological spaces monitored by algorithms reproduce power asymmetries. Thus, we see that algorithms are tools that have substantive—and varying—effects on organizational activities.

Attempting to theorize these dynamics, scholars have differentiated between human and nonhuman agency. For instance, Raisch and Krakowski (2021) highlighted the difference between the "augmentation" and "automation" perspectives on artificial intelligence, noting that organizations can have machines take over human tasks, or humans can collaborate with

machines. In a similar vein, Murray et al. (2021, p. 553) suggested that human and technological agency is "conjoined" and can be conceptualized in terms of assisting technologies, arresting technologies, augmenting technologies, and automating technologies. Drawing on such conceptualizations, Balasubramanian, Ye, and Xu (2022) developed theoretical insights about how the use of machine learning algorithms impacts organizational learning and Kemp (2023) explores how organizations can leverage AI to generate competitive advantage. Yet, such widespread perceptions of algorithms as tools or prosthetic devices (Callon, 2008), as exemplified in these various perspectives on agency, overlook the true nature of algorithmic organizing as entangled assemblages (Moser et al., forthcoming). This oversight ignores the ways in which algorithms are not passive instruments, but rather dynamic actants that shape and reshape organizational activities in profound ways.

The metaphor of organizations as algorithms builds on recent research that has challenged rigid conceptions of actor-based agencies (D'Adderio and Pollock, 2014; Kennedy and Phillips, 2023; Moser et al., 2022). This understanding of agency has three key implications for theory development regarding the use of algorithmic decision-making in organizations.

First, locating agency in the assembly highlights the central role of design activities and performative calculations in organizational life (Callon and Muniesa, 2005; D'Adderio et al., 2019). Ex ante design activities influence how the agency of the assemblage is performed (Glaser, 2017), not in a god-like designer sense, but in an emergent, ongoing sense (Garud et al., 2008). Designers attempt to construct preferred courses of action based on potential situations (Simon, 1970) wherein "algorithmic configurations" can be leveraged to perform calculations (Callon and Muniesa, 2005, p. 1242) that in turn can be used to monitor the external environment (Omidvar et al., 2023) or to rapidly evaluate the probable outcomes of different courses of action

(Davenport, 2018). At the same time, designers' intentions do not fully control organizational activities due to situational idiosyncrasies, interpretive flexibility (Pinch and Bijker, 1984), and inevitable overflows in situated action (D'Adderio, 2008; Suchman, 2007). As designing occurs in discrete "biographical moments" (Glaser, Pollock et al., 2021, p. 13) that are intrinsically messy, management theories that rely on artificial abstractions to distinguish between human and algorithmic agency are inherently limiting.

Second, it is crucial to recognize that agency can shift between multiple assemblages, rendering it myopic to focus exclusively on any one assemblage (Deleuze and Guattari, 1987; see also, Waardenburg & Huysman, 2022). Limiting the focus to either the algorithm or the human runs the risk of missing broader interactions between assemblages that shape organizational activities. To illustrate, credit scoring—an everyday example of algorithmic decision-making—requires analysis and theorization of multiple assemblages. This includes how credit agencies construct credit scores (Poon, 2007), how credit scores are used in other contexts like mortgage-backed securities (Omidvar et al., 2023; Poon, 2009), and how these scores can be used in more nefarious social situations (Hvistendahl, 2017; Pasquale, 2015). This results in a complex topology with multiple interacting assemblages, each retaining its own coherence. Therefore, it is essential to examine algorithmic decision-making holistically and account for interactions between different assemblages to develop a more comprehensive understanding.

Third, the metaphorical framing of organizations as algorithms enables us to differentiate between various modes of actorhood (Gehman et al., 2022), especially in the context of powerful algorithmic tools like LLMs. Because LLMs allow for idiosyncratic inputs from users and feature unique algorithmic outputs that change each time the model is run (Huyen, 2023), agency becomes assembled in a much more rhizomatic manner than in more traditional technologies.

Organizations approach this inherent challenge of algorithmic ambiguity in different ways, by either "accept[ing] this ambiguity … and building workflows around it" or "mitigating [the ambiguity] … by applying as much engineering rigor as possible" (Huyen, 2023). Put another way, the pursuit of artificial *general* intelligence that "benefits all humanity" (Open AI, 2023) paves the way for more rhizomatic assemblages that can be applied in a variety of contexts, such as education, medicine, software development, and management (Zhang et al., 2023).

In sum, conventional management perspectives that distinguish between human and algorithmic agency restrict our capacity to develop theory in the era of algorithmic decision-making and LLMs. By considering organizations as algorithms, we can position agency within assemblages instead of individual components, thereby transcending traditional, hierarchical notions of actorhood. This approach also enables us to move beyond limiting arborescent models of agency, which may become less relevant as the capabilities of AI tools expand.

Insight #2: Machine Readability Is the Foundation of Algorithmic Decision-Making

The organizations as algorithms metaphor focuses attention on the significant role played by data in organizing and decision-making. As observed earlier, algorithmic assemblages always include data. But these assemblages also speak in the sense that they produce additional data and metadata. Sociological perspectives in organization theory have highlighted the central role of data, particularly the powerful role that classifications—"a set of boxes … into which things can be put to then do some kind of work" (Bowker and Star, 2000, p. 10)—play as they codify categories that "valorize some point of view and silence another" (Bowker and Star, 2000, p. 6). This role of classification has become increasingly important, since "in today's systems of data extraction and analysis, properties of the individual are often inferred from digital traces" and the

classifications produced by the digital infrastructure "operate in increasingly totalizing, continuous, and dynamic ways" (Burrell and Fourcade, 2021, p. 227).

Zuboff's (2019) investigation of the political nature of data and the dynamics of data collection associated with the system she dubbed "surveillance capitalism" highlights the substantial control that Google, Facebook, Apple, Microsoft, and Amazon have over digital knowledge and its distribution (see also Zuboff, 2022). While recent research in sociology and management acknowledges the critical role of data in the new economy, advancing theory also requires recognizing digital data's inherent embeddedness in assemblages, both in terms of production and application, and its need to be machine-readable. Here, we emphasize two core implications of machine readability as a necessary condition for algorithmic organizing.

First, we need to understand the data used to train sophisticated algorithms such as LLMs, as it provides a foundation for and precedes any algorithmic analysis (Hannigan et al., 2019). For instance, one commonly used source of data is Common Crawl, a 501(c)(3) non-profit organization "dedicated to providing a copy of the internet to internet researchers, companies and individuals at no cost for the purpose of research and analysis" (Common Crawl, 2023). Common Crawl maintains records of "3.1 billion web pages" including "page captures from 43 million hosts" (Nagel, 2023). Other commonly used sources of data include Wikipedia, Project Gutenberg, BookCorpus, and Reddit links (Zhao et al., 2023). Beyond these examples of generalist data sources, some LLMs have incorporated specialist data sources to include scientific texts, multilingual texts, and even repositories of computer code (Zhao et al., 2023). Additionally, practices used to pre-process data before algorithmic models are trained involve interpretive moves that impact how algorithmic decision-making operates. Steps include filtering, de-duplication, removing personally identifiable information for privacy reasons, and

tokenization (Zhao et al., 2023). As Figure 1 shows, different models leverage different types of materials in their corpora, with significant impacts on algorithmic outputs (Zhao et al., 2023, p. 9), and ultimately, organizational activities.

-- Insert Figure 1 Here --

Second, in the context of algorithmic organizing and decision-making, it is important to understand how data are assembled for use. Given the narrow focus on digitized knowledge, information that is not in a machine-readable format is excluded, and data from historical periods may be disregarded. As a result, the institutional rules and structures underpinning and guiding organizational life may become taken-for-granted (Foucault, 1972) and cease to be mentioned, potentially rendering them entirely invisible because they have not been captured by the digital record (Green, 2004). Thus, it is critical to acknowledge the inherent bias in any corpora used for algorithmic organizing and decision-making, and to recognize that machine readability may privilege information gathered by the aforementioned surveillance capitalist giants, which may be (or may become) performatively corrupted (Zuboff, 2019, 2022).

To truly understand and develop management theory in the era of algorithmic decision-making and LLMs, we must recognize the critical role played by machine-readable data in shaping organizations—specifically, where it comes from and how it is assembled. Rather than seeing these processes as threats to the theorizing process, as do the 'Point' authors, we suggest that by embracing the metaphor of organizations as algorithms, scholars can better comprehend the complex ways in which data influence our understanding of organizations and systems, creating opportunities for more insightful and impactful theoretical development.

Insight #3: Programming and Prompts Are Sources of Expertise

The organizations as algorithms metaphor sheds light on the central role of prompting and programming in assemblages of algorithmic organizing and decision-making. Beginning with programming, it is important to emphasize that algorithmic models are tuned to meet human needs, and this often involves substantial interpretation through reinforcement learning based on human feedback (Christiano et al., 2023). For instance, Microsoft unintentionally trained a "racist" chatbot using language from Twitter; because the bot drew on "racist" language as its input, its output was similarly "racist" (Schwartz, 2019). Perhaps in response, organizations like Open AI and other LLM developers have implemented "adaptation tuning" to prevent unintended, socially damaging consequences and improve algorithmic output (Zhao et al., 2023). The adaptation tuning process involves significant amounts of human labor to train and validate algorithms to generate appropriate outputs (Zhao et al., 2023, p. 16), and often relies on unpaid and exploited labor to "format" data sets and define human needs (Crawford and Joler, 2018). Additionally, the process of "alignment tuning" is becoming increasingly crucial to ensure that algorithmic models adhere to human values such as helpfulness, honesty, and harmlessness (Zhao et al., 2023, p. 18). As a result, the programming underlying these algorithms involves values work (Gehman et al., 2013) that is performed both up front and over time—intentionally or not—creating opportunities for theorists to explore the social and interpretive processes involved in algorithmic tuning.

With regard to prompting, when we consider how agency occurs within an algorithmic assemblage, it is important to understand how LLMs learn in context through processes such as "chain-of-thought" prompting, which "provides a general yet flexible approach to elicit the reasoning ability of LLMs" (Zhao et al., 2023, p. 23). Research has shown that using "few shot"

prompts that provide more details improves LLM performance (Wei et al., 2023). Interestingly, generative agents can prompt each other based on a programmed "history" (Park et al., 2023) which begins to shift the notion of expertise from something imposed on a technology by an expert to a co-constituted process wherein skilled prompting becomes the nexus of expertise.

It is also important to recognize that LLMs are developing reasoning capabilities in ways that are emergent and not yet understood (Zhao et al., 2023). For example, LLMs have fabricated information about individuals in ways that are harmful, falsely stating that a law professor had committed sexual assault and that a mayor had served prison time for bribery (Edwards, 2023). This challenge of "hallucinating" algorithmic agents is important, and the social implications that emerge from algorithms favoring pattern matching over citational accuracy need to be explored and understood.

This links closely with another characteristic of algorithmic technologies that is increasingly influencing the nature of expertise: reduced transparency, and in some cases, complete opacity regarding how outputs are obtained (Stohl et al., 2016). This is particularly salient for machine learning programs that do not provide users with an understanding of the theoretical logic undergirding predictions (Faraj et al., 2018). Lebovitz, Lishitz-Assaf, and Levina (2022) highlighted the challenges of dealing with the opacity of artificial intelligence-based tools. They observed that when professionals interact with these tools, they often do not understand the reasoning behind the AI diagnosis or prescription, and consequently need to enact interrogating practices to determine whether or how to incorporate algorithmic recommendations. On the one hand, professionals can practice "engaged augmentation" by reflectively evaluating discrepancies between their professional judgment and algorithmic

judgment; on the other hand, professionals can practice "un-engaged augmentation" by either blindly accepting algorithmic recommendations or ignoring them (Lebovitz et al., 2022, p. 139).

Indeed, research on technologies, and specifically algorithms, has shown how they can reshape expertise and alter the nature of work (Anthony, 2021; Pachidi et al., 2021). However, this raises an inherent tension, as expertise often involves contextual judgments that may not be captured by algorithmic models (Pakarinen and Huising, forthcoming). Additionally, as the 'Point' perspective has highlighted, the constant change, invisibility, and inscrutability of artificial intelligence makes accounting for broad system dynamics difficult, but we, along with others (e.g., Anthony et al., 2023), see this as an opportunity for advancing a relational ethnographic perspective to unpack the processes at hand. Thus, as scholars are recognizing the profound impact of algorithmic technologies, we argue that the organizations as algorithms metaphor can advance our understanding of organizations, and thereby advance management theory, as this age of artificial intelligence continues to unfold.

In summary, the organizations as algorithms metaphor reveals that it is insufficient to focus solely on the technical aspects of algorithms. Thus, in contrast to what the 'Point' argument posits, we see immense opportunity for management theorists to broaden our scope and understand how programming and prompting are critical factors that shape algorithmic outputs, redefine expertise, and reflect human values. By considering these factors, we can gain a deeper understanding of how algorithmic organizing and decision-making works, and how it impacts scholars' theorizing efforts and society at large.

DISCUSSION

So far, we responded to the 'Point' concerns around corporate empiricism by presenting a broader view of big data and algorithmic processing, highlighting their potential to enrich management theory. We have proposed a new metaphor—organizations as algorithms—and contrasted it with three dominant metaphors of organizations as machines, organizations as organisms, and organizations as brains. Although these three metaphors have certain strengths, they also have important limitations relative to the widespread adoption of algorithmic organizing currently underway. Our exploration of organizations as algorithms surfaced three metaphorical insights, each of which depart from extant metaphors. First, the organizations as algorithms metaphor locates agency in assemblages. Rather than residing in humans or things, algorithmic organizing stresses interactions that comprise assemblages—that is, the assemblage is the actor (Deleuze and Guattari, 1987; Gehman et al., 2022). Second, viewing organizations as algorithms foregrounds the importance of machine-readability while exposing the limits of this criterion. At the extreme, legibility bounds intelligence, a nearly complete inversion of the typical relationship between scientific discovery and writing (e.g., Gehman, 2020; Husserl, 1970; Steele, 2014). Third, there is a de-centering of expertise itself. Programming and prompting emerge as sources of expertise, or symmetrically, as sites of ignorance (e.g., Gross, 2010; Merton, 1987).

Our perspective of organizations as algorithms thus differs substantively from the 'Point's perspective. Lindebaum, Moser, and Islam raise valid concerns about the trajectory of management theory, outlining a process model where corporate pressures to "scale up" evolve into flawed management theory through the creation of proxies and the resultant biased algorithmic decision-making. Yet, their model appears deterministic, overlooking the innovative

and adaptable ways management scholars can craft new theories alongside the rise of big data and algorithmic processes.

First, while we concede that blindly using algorithmically-processed corporate data to formulate theoretical concepts might lead to constructs that lack validity, it is easy to envision alternative future realities. A nuanced understanding of the assemblages that produce data in corporations can enable scholars to uncover new and valid theoretical constructs. As such, we assert that understanding the nature of corporate-produced data equips management scholars to navigate the challenges outlined in the 'Point' paper and that such understanding promotes robust theory development that is contextually relevant (e.g., in the age of artificial intelligence).

Second, it is important to note that management theories do not exclusively rest on the pillars of quantitative data, the kind often churned out by corporations. In discussing machine readability and the limits of legibility, we echoed some aspects of the 'Point' perspective, emphasizing that there are limits to what data can show and do. However, here we see significant opportunities for management scholars. For instance: What are the implications of the relationship between artificial intelligence and the fundamental need for machine readability? Now, perhaps more than ever, there is a pressing need to understand and conceptualize the qualitative aspects of data construction and use, and in particular the relationship between machine readable data, algorithmic decision-making, and values (Lindebaum et al., 2023). Consequently, the prospects for qualitative research in the age of big data and algorithmic decision-making appear both vital and promising. Below, we further explore these ideas, highlighting the research implications they present.

The Assemblage is the Actor

Although scholars have increasingly embraced post-Cartesian onto-epistemologies (e.g., D'Adderio, 2008; Glaser, Pollock et al., 2021; Orlikowski, 2007), the rise of algorithmic organizing makes such considerations more urgent. In this essay, we have emphasized the utility of an assemblage theoretic approach. For instance, building on Glaser, Pollock et al. (2021), assemblages encompass a range of sociomaterial components that are deeply entangled and performative. These include humans, artifacts, theories, and other features that contribute to the making and remaking of an algorithm or, essentially, any technology (D'Adderio, 2008, 2011; Glaser, 2017). Enacting such an assemblage involves accounting for all the relational and distributed sociomaterial features that contribute to the technology's construction and maintenance. Depending on how these features are configured, assemblages develop the capacity to act in different ways that ultimately impact how successfully they come to constitute the world around them (Çalışkan and Callon, 2010).

Taking an assemblage theoretic approach, then, allows one to avoid taking sides in various debates regarding, for example, the benefits of augmentation versus automation (Raisch and Krakowski, 2021), or the relative merits of assisting, arresting, augmenting and automating technologies (Murray et al., 2021). These distinctions resonate with what Callon (2008, p. 43) described as a prosthetic view, which aims to "equip the person with tools, competencies, and resources that will enable her to overcome some of her limits." Although prosthetics provide actors with a "capacity to act and move in society," these are limited to the courses of action allowed by and inscribed in the protheses (Callon, 2008, p. 44; see also, Akrich, 1992). What Callon described as a habilitation view also seeks to enable action, but the institutional

environment is modified rather than an individual's actions (i.e., through the use of available tools). The aim is to put actors in a position to conceive and accomplish their own projects.

According to Callon (2008, p. 45), prosthetics and habilitation are "two symmetrical approaches." Both aim to compose agency, "the former by acting primarily on the person, the latter by striving to transform the environment" (Callon, 2008, p. 45). What makes them symmetrical is their common assemblage theoretic foundation (Callon used the original French term *agencement*). Whereas a prosthetic view tends towards the arborescent end of the spectrum, the habilitation view is more rhizomatic. "Habilitation constantly allows for the appearance of new possibilities, whereas the prosthesis limits the possible fields of action" (Callon, 2008, p. 45). And, consistent with Gehman et al.'s (2022) notion of hybrid assemblages, Callon concedes that the two views are not mutually exclusive. On the one hand, the prosthetic view locates agency as embedded in devices which define available lines of action in relatively restrictive ways. On the other hand, the habilitation view allows for a multiplicity of possibilities.

Applied to the question of algorithmic organizing, an assemblage perspective invites an inquiry into the precise forms and effects of AI in particular circumstances. Rather than starting a priori with one view of AI or another, it seems important to leave open the questions of prosthetics versus habilitation and arborescent versus rhizomatic. Instead, we can ask: How and why does algorithmic organizing tend to take one direction in some situations, but another direction in other situations? When are prosthetic assemblages more (or less) effective? When are habilitative assemblages more (or less) effective? Are certain aims better suited to some modes of assembly than others? We suggest that the metaphor of organizations as algorithms provides an affordance which management scholars can use to shine light on these important questions.

Machine Readability and the Limits of Legibility

At the core of AI is an immense corpus—but one that is machine readable. This is both a strength and a limitation. In much the way Wittgenstein mused that the limits of our vocabulary are the limits of our world, the world of AI is at once vast and yet truly finite. On the one hand, as Foucault (1977, pp. 197, 214) pointedly observed, the disciplinary society is an "uninterrupted work of writing," "an immense police text," and "a complex documentary organization." On the other hand, that which is most taken for granted is not recorded (Gehman, 2020) and fails to produce oddities (Steele, 2020). Put neatly, "To take something for granted is to be indifferent to any concern or call for preservation. A history of obviousness, then, is a uniquely invisible history" (Dodd, 2004, p. 82).

In addition to the problem of taken-for-grantedness, there are well known problems in codifying tacit knowledge (e.g., Dreyfus, 1978). For example, when we asked ChatGPT about the limits of AI when it comes to tacit knowledge, it told us: "One of the main limitations of AI in dealing with tacit knowledge is that it relies heavily on large datasets and explicit rules." According to ChatGPT, another challenge is that tacit knowledge "often involves context-dependent and situational knowledge that is difficult to generalize across different contexts or domains." And finally, AI "still lacks the creativity and intuition that are often required to apply tacit knowledge effectively." Surprisingly, AI has limited knowledge of its own explicit knowledge base. Not only do AI models typically not recognize what they do not know, they also do not know how they learned what they know. For instance, we asked ChatGPT about the most referenced documents in its corpus, to which it replied: "As an AI language model, I do not have access to the exact details of the corpus underlying me, including the most frequently referenced

documents." The image that comes to mind is akin to a library without a catalog: there is no meta data about the data.

Beyond questions of the written, the taken for granted, and the tacit, however, there is still the problem of machine readability. This is a bar that goes beyond mere writing. One way to apprehend the impact of this on algorithmic organization is by way of analogy. Recently, Netflix announced it was shutting down its DVD-by-mail business completely (Burr, 2023). Although this may seem perfectly rational in the streaming era, many movies have never been available via any streaming service. In other words, "entire swaths of cinema history come closer to winking out of the average consumer's consciousness, and that's bad news for the public in general and film lovers in particular" (Burr, 2023). This is a microcosm of the legibility problem (Steele, 2014): to the extent that important knowledge resides in archives or even in poorly rendered PDFs, it risks being forgotten, much like many DVDs or VHS tapes.

These observations suggest multiple lines of inquiry. To the extent that algorithmic organizing rests on corpora, the practices of constructing such corpora become critical. There are basic questions, such as about what is included and what is excluded, and how these choices are made. Some choices may be the result of little more than the path of least resistance, but others could have more consequential explanations, with implications for issues such as diversity, equity, and inclusion. Beyond merely following what is in or out, there are questions about pre-processing techniques. What transformations have been implemented, and how Procrustean were these transformations? Stepping back from specific practices, there also are questions of big picture consequences. For instance, what is the relationship between data sources and outcomes? The answers to these questions have profound implications for management scholars, for the design of algorithmic organizations, and for public policy and regulation.

The Prompted Organization and the Organization of Prompts

The metaphor of organizations as algorithms foregrounds a singular phenomenon: the prompt. To organize algorithmically is to be prompted. In a very real sense, the prompt becomes the site of organizing. Rather than resources, routines, capabilities, or practices, the locus of algorithmic organizing is the prompt. Importantly, the prompt has two faces. On the one hand, the prompt perturbs the organization and demands a response. On the other hand, the response requires prompting. Without a prompt, nothing happens. This raises interesting questions about where expertise resides and what constitutes expertise. Does expertise reside with the prompter, the one who elicits the organization's knowledge? Or does expertise reside in the responses the organization can provide? Consistent with our assemblage theoretic perspective, the answer clearly is both. Importantly, other important questions also arise at the interface of the algorithmic organization.

Another aspect of this prompt-response interface relates to the practices used to evaluate AI tools. For instance, Lebovitz et al. (2021) highlighted the challenges of evaluating AI tools, especially in contexts fraught with uncertainty. Their insights derive from a study of a hospital that was evaluating five different AI tools. Although all five tools "reported high performance according to standard AI accuracy measures … based on ground truth labels provided by qualified experts, … none of them met expectations" in practice (Lebovitz et al., 2021, p. 1501). The authors concluded that the tools failed to meet expectations because they had been trained on highly uncertain expert "know-what knowledge." Ordinarily, experts deal with this uncertainty by drawing on "rich know-how practices," but as we have seen above, such embodied knowledge is not codifiable by AI tools.

Looking ahead, a more thorough examination of the practices involved in algorithmic organizing is warranted, specifically with regard to prompts, responses, and coding procedures. Of particular concern are the values implicated in these processes (e.g., Lindebaum et al., 2022). To function effectively, algorithmic organizing necessitates significant interpretive labor. Zhao et al. (2023) highlighted the central role of alignment tuning in ensuring that generative AI solutions adhere to human values such as harmlessness, honesty, and helpfulness. However, it is important to question why these values are prioritized and whether other socially important values should also be considered, even if they are socially disputed (e.g., Haidt, 2013). Furthermore, it is crucial to investigate how human feedback is utilized to instill human values in algorithmic processes, such as through reinforcement learning (Christiano et al., 2023). Who are the individuals responsible for customizing LLMs, and is it possible to customize them at the organization level? Grasping the values-laden work involved in algorithmic organizing is vital for management scholars to skillfully traverse the intricate ethical and social consequences of this rapidly changing phenomenon (see also Metz, 2023). By cultivating theory that could be applied to increase the possibilities that AI's prospective advantages are achieved and likely damages are reduced, researchers can promote more responsible development and deployment of these transformative technologies.

CONCLUSION

In the dynamic landscape of algorithmic organizing, we do not see the twilight of management theory, but rather the dawn of exciting new theoretical possibilities. This era calls for a fresh metaphor, and 'organizations as algorithms' is well suited. Our metaphor invites us to view algorithmic organizing not merely through the lens of existing frameworks, such as routines or institutions, but as a distinct phenomenon meriting its own theoretical exploration. This

perspective enables us to transcend simplistic narratives that either valorize or vilify algorithmic organizing and the effects of this phenomena on theorizing processes. As scholars explore this complex and evolving terrain, the metaphor of organizations as algorithms equips us with a more nuanced understanding of contemporary organizations and the new social and economic realities they provoke.

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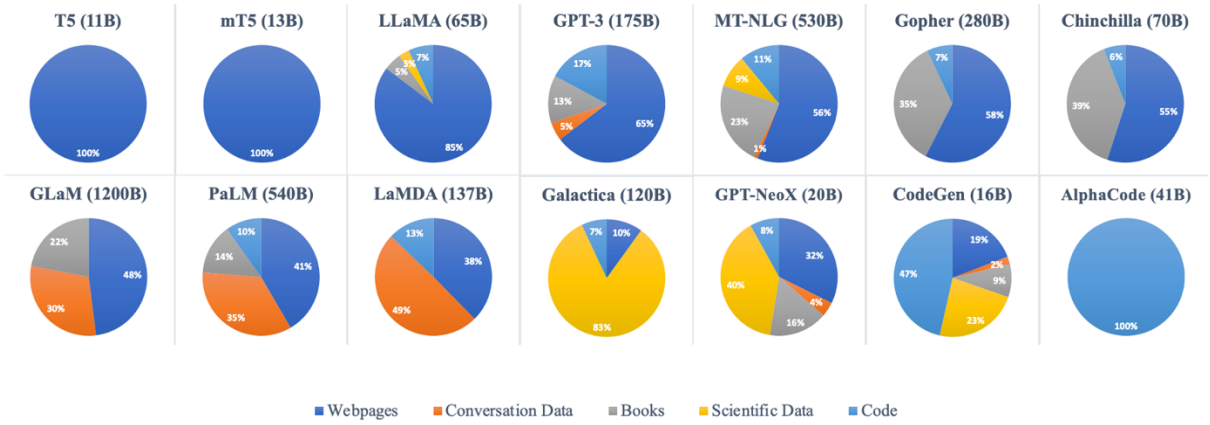
FIGURE 1. DATA SOURCES FOR EXISTING LARGE LANGUAGE MODELS



Ratios of various data sources in the pre-training data for existing LLMs. Adapted from Zhao et al. (2023, p. 9). Numbers may not add to 100% due to rounding.

TABLE 1. METAPHORICAL PERSPECTIVES ON ORGANIZATION

Dimension	Metaphor			
	Organizations as machines	Organizations as organisms	Organizations as brains	Organizations as algorithms
Description	Machines are systems of parts that work together to complete mechanized tasks	Organisms are living systems that survive through environmental adaptation	A brain is a specialized and distributed system that processes information and makes decisions	Algorithms are entangled in assemblages that also include data, decisions, and routines
Theoretical roots	Division of labor, scientific management, Fredrick Taylor, Max Weber	Darwin, open system theory, organizational psychology, contingency theory, population ecology	Carnegie School, dynamic capabilities, cybernetics, double-loop learning	Assemblage theory, sociomateriality
Metaphorical affordances				
How is the environment conceptualized?	Stable	Evolving	Changing	Co-Constituted
How does the organization interact with the environment?	The organization controls the environment by dividing tasks, creating rules and regulations, giving orders, and exacting obedience	The organization adapts its form to environmental conditions to ensure its survival; otherwise, it fails	The organization scans the environment, anticipates changes, and potentially recreates itself through learning processes, routines, and so forth.	The organization is composed of a set of assemblages that process machine-readable data
Where is agency located?	The expert makes the decisions	The environment does the selecting	Agency is diffused across actors	The assemblage has agency
What prescriptions guide strategic action?	Structure and rationalize all activities to maximize efficiency	Focus on adaptation and on satisfying needs	Allocate resources toward organizational learning	Programming and prompting efforts cannot control the future; assemblages gain and lose territory
Strengths	Works well for straightforward tasks in stable environments	Encourages a processual approach to understanding organizations; focuses attention on organizational “needs” and different organizational “species”	Allows for learning; encourages innovation through diffuse leadership and management	Locates agency within assemblages; identifies the crucial role of machine readability; highlights the centrality of programming and prompts
Limitations	Downplays human aspects of organization; does not work well in dynamic environments; can dehumanize individuals	Discounts the socially constructed nature of organizational life; the assumption of functional unity ignores politics	There is no coherent view of the brain; overlooks issues of power and control; what needs to be learned is not always clear	Unnecessarily complex for stable environments; blurs distinctions between actants within an assemblage, making accountability difficult to assign