Strategic leadership and ubiquitous ambient intelligence

A new approach to reconcile exploitation and exploration in the Fourth Industrial Revolution?

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18. Strategic leadership and ubiquitous ambient intelligence: a new approach to reconcile exploitation and exploration in the Fourth Industrial Revolution?

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INTRODUCTION

The Fourth Industrial Revolution (4IR) represents a challenging information era for strategic leaders. Schwab (2017, p. 3) notes that the 4IR will revolutionize our relationship with new information, through unprecedented velocity, scope, and systems-wide interconnectedness of information. For instance, the World Economic Forum states that "[b]y 2025, it's estimated that 463 exabytes[1] of data will be created each day globally" (Desjardins, 2019, n.p.) – a number that is prodigiously larger than 5 exabytes, which is the estimated equivalent of all the words ever spoken by humankind. This prediction would imply that the 4IR will catapult strategic leaders into a big data world that far exceeds our basic human capacity to process new information from our environment (Marois & Ivanoff, 2005). How, then, can strategic leaders reconcile the demands of continuity and change in the unprecedented informational environment of the 4IR?

Strategic leaders face the perennial challenge of balancing continuity and change (Lubatkin et al., 2006). The spirit of this tension was seminally articulated by March (1991) as the tension between exploitation and exploration, respectively (see also Wilden et al., 2018). Yet, the activities associated with exploitation and exploration are paradoxical – sensible in isolation, but incompatible or even absurd in conjunction (Knight & Paroutis, 2017; Matthews et al., 2022; Papachroni et al., 2015). Perhaps most challenging for strategic leaders is that organizational longevity ultimately hinges on some degree of simultaneous pursuit of both exploration *and* exploitation activities (Fourné et al., 2019; Junni et al., 2013). Thus, the ability to reconcile competing demands of exploration and exploitation is a necessary condition for organizations to thrive (Oehmichen et al., 2017).

Strategic leadership entails "the functions performed by individuals at the top levels of an organization (CEOs, TMT[2] members, Directors, General Managers) that are intended to have strategic consequences for the firm" (Samimi et al., 2022, p. 3). Accordingly, a crucial task for strategic leaders is the continuous search for new ways of reconciling paradoxes of exploration and exploitation. However, strategic leaders remain humanly constrained in their ability to process new information from the environment. Overcoming this human constraint could thus provide organizations with a competitive edge, as processing new information is key to finding creative, bespoke, and unconventional synergies between exploration and exploitation activities (Miron-Spektor et al., 2018; Sidhu et al., 2020). Although strategic leaders have

traditionally simplified these information-processing demands by, for instance, structurally separating exploration and exploitation demands (Fourné et al., 2019; Jansen et al., 2009), the 4IR is radically changing the information environment within which strategic leaders operate. By necessity, then, strategic leaders will be challenged to find viable ways to improve their information-processing capacity, such as through smart assistive technologies.

In this chapter, we draw attention to ubiquitous ambient intelligence (UAmI) as a fast-emerging smart concept (Dunne et al., 2021). UAmI captures a smart digital environment that proactively, sensibly, and pervasively interfaces with human decision-makers, with the potential to fundamentally reshape the way strategic leaders interface with the information environment in the 4IR. Dunne et al. (2021, p. 1) note that "Ambient Intelligence (AmI) is the application and embedding of artificial intelligence (AI) into everyday environments to seamlessly provide assistive and predictive support in a multitude of scenarios via an invisible user interface." In so doing, UAmI *interprets* and *predicts* the environment in real-time, drawing on ubiquitous computing, sensors, hyper-connected networks, and human–computer interfaces (Augusto, 2007; Dunne et al., 2021), going beyond retroactive *descriptions* espoused by current business intelligence tools available to strategic leaders. As such, UAmI moves strategic leaders' exposure to new information from descriptive information to predictive intelligence that can complement, perhaps even alleviate, the increased human information-processing burden in the 4IR.

We advance a new vantage point for examining how strategic leaders can interface with new smart technological concepts (such as UAmI) to help reconcile paradoxical tensions in the 4IR. In doing so, we introduce a new question to this literature: how can strategic leaders enhance their information-processing capacity to reconcile the tensions of exploration–exploitation in the 4IR era? To spearhead research into this topic, we build on the premise that at the core of reconciling paradoxes is the organization and its leaders' ability to process information, especially new information that allows for finding creative synergies in paradoxes through reinterpreting and challenging extant beliefs and solutions. Then, we introduce the potential role of smart technological concepts like UAmI into this debate.

The chapter is structured as follows. After exploring the conceptual background, we then recast exploration–exploitation paradoxes in the context of the information environment of the 4IR, highlighting how the information environment is projected to change in the 4IR and how this affects our assumptions of existing solutions. In doing so, we develop an integrative framework in two dimensions: domain of intelligence (individual vs collective) and context (traditional vs 4IR), forming four quadrants (see Figure 18.1). We use this framework as a structure of discussion on different information-processing mechanisms in each quadrant. In the first two quadrants (individual and collective intelligence in the traditional context), we revisit the ambidexterity literature to discuss the strengths and limitations of traditional approaches to solving these paradoxes given the demands of the new information environment. Then, we briefly revisit the utility of traditional assistive business information systems (e.g., decision-support systems, competitive intelligence, expert advice) and their utility for exploration and exploitation while also highlighting their shortcomings in the 4IR era. We then proceed to the other two quadrants (individual and collective intelligence in the 4IR context) by introducing new technological concepts that promise to be centerpieces of the 4IR (e.g., UAmI), which may address some of the information-processing limitations faced previously by boundedly rational strategic leaders. We conclude with a research agenda and practical implications of our discussion.

CONCEPTUAL BACKGROUND

Strategy is conditioned, directed, and shaped by the capacity of strategic leaders to process information from the information environment (Sidhu et al., 2020). Information processing generally entails the *acquisition*, *exchange*, and *application* of inputs from the environment (Van Doorn et al., 2017). Information processing is key to reconciling paradoxes of exploration and exploitation, which require thinking that goes beyond the confines of single-knowledge domains to find synergies where there only seem to be contradictions (Benner & Tushman, 2003; Matthews et al., 2022). This is particularly done by enabling creativity (Bechtoldt et al., 2010; De Dreu et al., 2011), a distinct human attribute that can drive change and non-traditional thinking in organizations (Gielnik et al., 2012; Matthew, 2009). Yet, strategic leaders are boundedly rational, with restricted ability and motivation to process information, especially new information (Puranam et al., 2015; Van Doorn et al., 2017).

We examine the position that the will fundamentally change how strategic leaders interface with new information (and, thus, their ability to reconcile paradoxes of exploration and exploitation), as smart technologies, such as the Internet of Things (IoT), cloud computing, big data, digitalization, and cyber-physical systems become default features of the everyday information environment (Gastaldi et al., 2022; Mahmood & Mubarik, 2020). To the extent that the ability to reconcile paradoxes hinges on strategic leaders' ability to process information from their environment, the 4IR may require new theories, tools, and solutions to help strategic leaders thrive (Simsek et al., 2019).

The Changing Information Environment in the Fourth Industrial Revolution

Schwab (2017) proposed that we can expect that the 4IR will be characterized by several discernible, but mutually reinforcing, changes in the information environment. The World Economic Forum estimates that "the entire digital universe is expected to reach 44 zettabytes[3] by 2020" (Desjardins, 2019, n.p.), which they estimate as "40 times more bytes than there are stars in the observable universe." These changes are notably catalyzed by the IoT, where Li et al. (2015) note that the IoT entails "an inter-connected world-wide network based on sensory, communication, networking, and information processing technologies" (p. 244). Schwab further highlights that we can understand the changing informational environment along the changing speed at which information is produced (velocity), changing scope of information (in terms of depth and breadth), and the interconnectedness of informational inputs (system impact).

First, the *velocity* with which information is generated will change, from additive to exponential. The half-life of information will be unprecedented, with competitive insights decaying exponentially. Mindbogglingly, the World Economic Forum further suggests that "[b]y 2025, it's estimated that 463 exabytes of data will be created each day globally" (Desjardins, 2019, n.p.). This represents a change in the quantitative nature of information, as well as our chronological interpretation of strategic horizons (i.e., mismatch between chronological time and subjective experience of time). Studies have identified how information speed in the environment is related to exploration and exploitation (Nadkarni et al., 2016). Although the infrastructural elements are already in place to accommodate this speed, such as cloud computing and distributed ledger systems (Lumineau et al., 2021), strategic leaders will face the need to convert exponential-speed volumes of data into meaningful organizational solutions.

Second, the *scope* of information will change, highlighting the qualitative changes in the depth and breadth of information. Several studies have influentially shown the importance of both depth and breadth of information in fueling exploration and exploitation strategies (Ferreras-Méndez et al., 2015; Kobarg et al., 2019; Terjesen & Patel, 2017). Although previously distinguishable attributes, the distinction between depth and breadth of information may become blurred, as information becomes instantaneous and intelligently interpreted in real time. This shift blurs traditional distinctions between data, information, and knowledge, to a focus on intelligence that permeates the strategic leadership function.

Finally, the 4IR is predicted to have a greater informational *interconnectedness* across value-chain activities, stakeholders, and even nations. The origin (quality and intellectual property, IP) of information will become almost impossible to pinpoint, as numerous extra-organizational actors participate in co-creation of information (Foege et al., 2019; Wadhwa et al., 2017). While this allows for enriching the informational environment, information becomes less proprietary, democratizing its usage. This not only makes it more difficult to ascertain quality and attribute the source of IP (Tekic & Willoughby, 2020; Ullah et al., 2021), but also more difficult to distribute and capture rents (Foege et al., 2019; Laursen & Salter, 2014; Wadhwa et al., 2017) and enact adequate digital governance (Hanisch et al., 2023). That is, as the sources of relevant information become more decentralized and interconnected, it becomes difficult, if not impossible, to attribute or rely on single defined origins as a source of information.

The aforementioned developments highlight some of the remarkable ways in which the 4IR will reshape the information environment in which strategic leaders operate. Yet, despite the radically changing information environment, our inherent human capacity for processing information has been approaching its asymptotic limit (see Marois & Ivanoff, 2005; Shin et al., 2020 for a broader discussion on information-processing capacity and social evolution). This information-processing capacity is further tasked when an individual needs to devote capacity to executing tasks simultaneously (Marois & Ivanoff, 2005). Extrapolating this notion of strained capacity to our context, Dieste et al. (2022, p. 1) note that in the 4IR, "organizational environments become more global, dynamic, and competitive, thereby intensifying contradictory demands." These distinctive changes of the 4IR can be linked to the main question that we have posed: how can strategic leaders manage information-processing capacity to reconcile the tensions between exploration and exploitation in the 4IR context?

We briefly revisit the traditional solutions to exploration–exploitation paradoxes, before engaging with new concepts such as UAmI that may assist strategic leaders. As a structure of discussion, we use an integrative framework (Figure 18.1) to further contrast UAmI in the 4IR context with traditional solutions at two levels of intelligence domains: individual and collective intelligence. This approach reveals four possible archetypes of strategies for reconciling exploration–exploitation paradoxes: bounded rationality, boundary spanning, transitioning, and synergizing. For each quadrant, we indicatively characterize the information-processing mechanisms and describe how strategic leaders may resolve exploration–exploitation paradoxes. This approach allows us to take the conversation from generic views of how UAmI plays a role in information processing to an even more contextualized approach under different configurations.

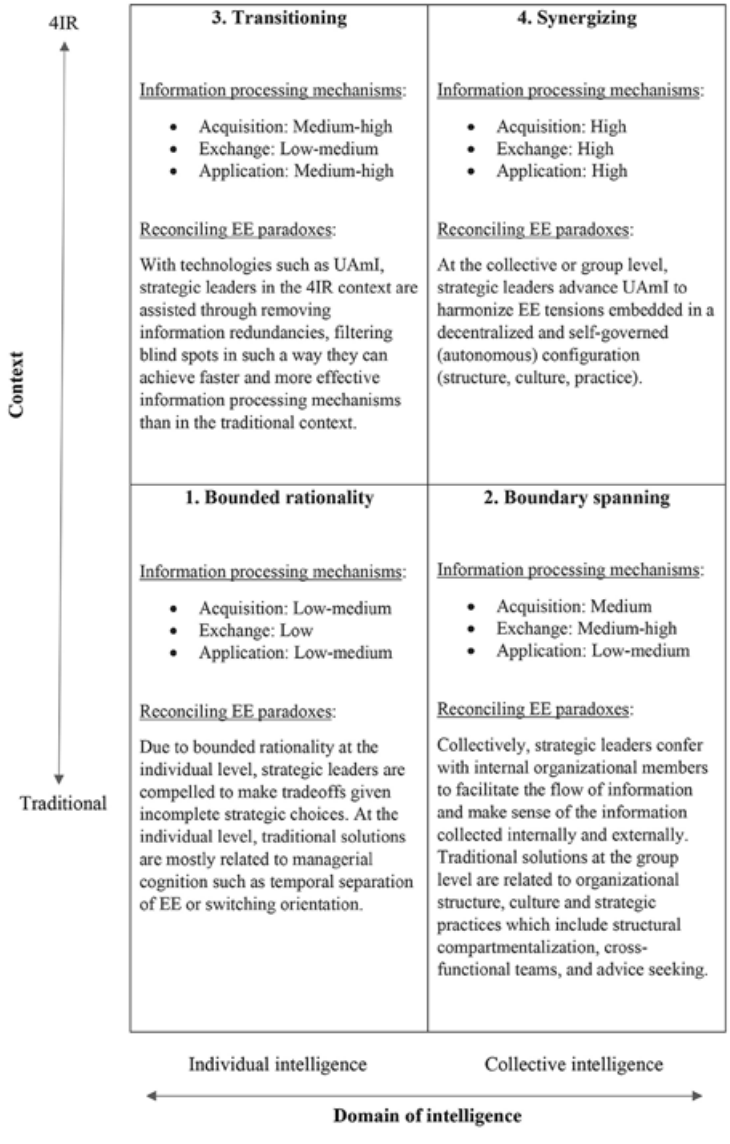

Figure 18.1 *Reconciling exploration–exploitation (EE) paradoxes in two dimensions: context (traditional vs 4IR) and domain of intelligence (individual vs collective)*

REVISITING TRADITIONAL SOLUTIONS TO EXPLORATION–EXPLOITATION PARADOXES: BOUNDED RATIONALITY AND BOUNDARY SPANNING

The ability to reconcile paradoxes of exploration–exploitation is constrained by the bounded rationality of strategic leaders (e.g., limited information-processing capacity). To cope, strategic leaders have sought to design organizational solutions to simplify, compartmentalize, and manage paradoxes along their internally consistent elements (e.g., co-organizing efficiency and reliability activities commonly associated with exploitation; co-organizing risk, venturing, and experimental activities for exploration), a process centrally captured in the literature on ambidexterity (Fourné et al., 2019; Junni et al., 2013; Lavie et al., 2010; Turner et al., 2013).

Knight et al. (2020) provide a useful distinction in organizational design dimensions where we can expect paradoxes to be particularly visible (i.e., where they are "felt"): cognition, structure, culture, and practice of strategy. In the first quadrant in Figure 18.1 (bounded rationality), the individual intelligence is mostly related to managerial cognition, while for the second quadrant (boundary spanning) collective intelligence entails organizational structure, culture, and strategic practices. We draw on this distinction to provide a flavor of how these paradoxes have been solved in the past and how the information environment of the 4IR might affect those traditional solutions.

Bounded Rationality Quadrant

Managerial cognition

First, exploration and exploitation affect managerial cognition (Stubbart, 1989), or how decision-makers interpret their environment to make sense of competing demands (Nadkarni & Barr, 2008). To address this dual demand, strategic leaders often emphasize either exploration or exploitation at any point in time (i.e., use temporal separation), switching to periods of different intensity towards each, which allows the organization to focus on compatible attributes during simple periods before switching to a different orientation. Consistent with Tushman and O'Reilly (1996), the sequential solution to solving paradoxes allows for attention to be devoted primarily to *either* exploration or exploitation (see Simsek et al., 2009 for a discussion on different ways of organizing sequentially). The key strategic leadership challenge, in this approach, is optimizing the timing of switching between orientations. However, against the previously discussed changes in the information environment of the 4IR, we can expect information overload to impede the ability of strategic leaders to process information. The need for switching focus between exploration and exploitation may become too frequent, making the distinction between different emphases less evident.

Boundary Spanning Quadrant

Organizational structure

Perhaps the most visible manifestation of exploration and exploitation paradoxes is in organizational structure. Organizations are structured to support specific roles and activities, allowing for efficiency in coordination and consistency (Fourné et al., 2019). Traditionally, an elegant solution has been to structurally separate exploration and exploitation activities, with dedicated mechanisms (e.g., cross-functional teams) to integrate and reconcile their demands

as needed (Jansen et al., 2009, 2012). This solution minimizes the need and involvement of the entire organization in reconciling paradoxes, but allows members to function in defined and internally consistent activities. However, the 4IR is fundamentally changing the way organizations are structured through formalization of roles and specialization of skills. Platform organizations, complex matrix structures, open strategy, and ecosystem organization (Volberda et al., 2001) make the structural locus of exploration and exploitation activities less clear (see Park et al., 2020 for a recent treatment).

Organizational culture

Third, paradoxes of exploration–exploitation are felt in organizational culture. Traditionally, to balance the coexisting demands of exploration and exploitation, strategic leaders have sought to cultivate cultures characterized by stretch goals, discipline, support, and trust, as captured in the stream of literature on "contextual" ambidexterity (Gibson & Birkinshaw, 2004). Some authors have already drawn attention to traditional approaches of building culture in the 4IR, as the allied revolution has also brought about increases in remote working and gig work, which has changed the spatial conception of the traditional workplace (Bag & Wood, 2022). With workforce decentralization, greater specialization through casualization, and increased autonomy of big data scheduling and decisions, there is lower human involvement in the physical boundaries of organizations, where culture is typically nourished (Smollan & Morrison, 2019; Zerella et al., 2017). Accordingly, it is now more challenging to create a uniform strategic narrative to help a fragmented workforce find ways to reconcile exploration and exploitation in their daily tasks (Knight & Paroutis, 2017).

Strategic practice

Finally, paradoxes are experienced in the practice of strategy, which occurs throughout the organization as organizational members "make strategy work" (Jarzabkowski & Balogun, 2009; Weiser et al., 2020). Notably, the traditional means of managing paradoxes of continuity and change has been to make clear distinctions between strategy formulation and strategy implementation. However, in the 4IR, these distinctions have become blurred (Heyden, Fourné et al., 2017) as a result of changing organizational forms such as decentralized autonomous organizations (DAOs) (Singh & Kim, 2019). With more decentralized organizations in the 4IR, ownership of strategy processes becomes less clear and the roles of implementation and formulation become less distinguishable (Heyden, Fourné et al., 2017; Lee & Puranam, 2016).

We summarize the challenges of these traditional solutions, which call for new approaches, in Table 18.1. Although historical solutions remain foundational to our understanding of how to manage exploration and exploitation more generally, the informational environment of the 4IR could blur the bounds of space and time in organizing activity (Knight & Paroutis, 2017; Schwab, 2017), making traditional solutions less effective, even impeditive – which is why we call for embracing new ways of addressing paradoxes of exploration and exploitation in the 4IR.

Traditional Assistive Technologies for Navigating the Informational Environment

The challenges identified can be interpreted as changes in the information-processing requirements imposed on strategic leaders as they try to reconcile exploration and exploitation in the 4IR. If we recall that information processing entails acquisition, exchange, and application of

Table 18.1 Recasting exploration and exploitation solutions in the Fourth Industrial Revolution

Strategic Domain	Exploration–Exploitation Paradox to Be Solved	Traditional Solution	Information-processing Challenges for Strategic Leaders in the 4IR
Bounded rationality			
Managerial cognition	Allocating scarce attentional and cognitive resources to competing priorities and opportunities	Temporal separation by managing trade-offs and switching between tasks (Kim et al., 2012; Tempelaar & Rosenkranz, 2017), Transitioning/switching between evolutionary and revolutionary change (Tushman & O'Reilly, 1996)	Transitioning: informational overload due to non-linearity and exponentiality of information produced requiring processing at greater velocity, more complex scope, and more integrated system bounds
Boundary spanning			
Organizational structure	Structurally differentiate and (re) integrate exploratory and exploitative activities	Structural compartmentalization and cross-functional specialization (Fourné et al., 2019; Jansen et al., 2009)	Porous boundaries: decentralized organizational eco-systems, prone to cross-contamination of knowledge elements. Functional boundaries of organizations becoming less clear
Organizational culture	Cultivate internal cultures that enable sustained levels of high exploration and exploitation behaviors	Harmoniously fostering an organizational context through high-performance systems (Gibson & Birkinshaw, 2004; Mom et al., 2009; Patel et al., 2013)	Ambiguity: ambiguity requires articulating and communicating dialectical strategies in loose cultures (e.g., gig work, casualization, remote work)
Practice (top-middle-frontline)	Distribute exploration and exploitation activities across managerial hierarchy and functions	Hierarchical domain separation (Conway & Monks, 2011)	Role agency: changing and blurring roles in initiating and executing change, while informational ownership and role agency become less distinguishable

Source: Based on perspectives from Fourné et al. (2019); Junni et al. (2013); Knight et al. (2020); Lavie et al. (2010); Simsek (2009); Simsek et al. (2009).

new information, improving information-processing capacity has a long tradition of inquiry, starting with the seminal work on absorptive capacity (Cohen & Levinthal, 1989, 1990). At the individual level, information-processing capacity entails "the total number of linearly independent functions of input stimuli the system can compute" (Li et al., 2022, p. 1). To navigate their informational environment, strategic leaders rely on several assistive systems to help them process their information environment and make decisions; most commonly, these are decision-support systems, market-competitive intelligence, and (expert) advice-seeking. These information-processing support mechanisms have different utilities for exploration or exploitation.

First, the literature on decision-support systems and computer-aided decision support has been insightful. For instance, enterprise resource planning (ERP) systems have been a staple

Table 18.2 Traditional perspective on assistive decision-support mechanisms

	Information Processing Mechanisms			Utility for Exploration and/or Exploitation
	Acquisition	Exchange	Application	
Decision support systems	Low-medium	Low	Low-medium	Particularly useful for the "bounded rationality" quadrant with the purpose of internal exploitation
Business intelligence	Medium	High	Low	Particularly useful for the "boundary spanning" quadrant, such as for market-side exploration
Advice	Medium	Medium-high	Medium	Either/both, depends on source, quality, and nature of advice

of traditional organizations for decades. They are particularly useful for exploitation solutions, as they help optimize and find efficiencies within set parameters (Kowalczyk & Buxmann, 2015). Second, market-competitive insights such as Microsoft Power BI are good for exploration and determining ways of differentiating the market via customized reporting (Trieu, 2017). They are notably useful for environmental scanning and helping the organization identify its space in a market place with clearly defined competitors. Third, human-based decision support has been captured through the notion of advisers (Alexiev et al., 2010, 2019), which can be useful for transferring expertise and applying tacit knowledge (Kämmer et al., 2023; Menon & Pfeffer, 2003). Although advisors are useful, they are costly and also prone to biases (e.g., survivorship bias), so that they tend to be more useful for one-off, discretely specified problems (Heyden et al., 2013; Kämmer et al., 2023).

We summarize the utility of these information-processing support systems in Table 18.2, along with the information-processing sub-processes noted earlier (i.e., acquisition, exchange, application). Yet, there are a couple of noteworthy limitations of these support systems in the 4IR. First, although some of these systems are likely to persist, the information challenge is expected to be so exceptional in the 4IR that it possibly exceeds the traditional strengths of these support systems. Second, a common assumption is the linear process in all these models. The 4IR will radically challenge the linear stepwise assumption behind these models. How, then, can strategic leaders improve their information-processing capacity? What will assistive information-processing tools and systems look like in the 4IR? In the next section, we draw attention to UAmI.

STRATEGIC LEADERSHIP AND TECHNOLOGY INTERFACE IN THE 4IR: THE PROMISE OF UAmI

The previous section calls for increased attention to the need for a changing relationship between strategic leaders and traditional assistive technologies to better navigate the informational realities of the 4IR. Gastaldi et al. (2022, p. 3) emphasize that the 4IR is characterized by smart technologies, which is an umbrella term capturing concepts such as "advanced automation (e.g. collaborative robots), additive manufacturing, augmented human-machine interface technology (such as e.g. augmented and virtual reality), simulation, cloud manufacturing… Industrial Internet of Things, big data analytics (including artificial intelligence) and cyber

Table 18.3 Example of UAmI concepts and tools

UAmI Concept	Key Functionality	Reference Points
Virtual assistant	Voice-activated personal assistant to perform tasks, answer questions, and control smart home devices (e.g., Alexa, Cortana, Siri, Google Assistant)	Abdolrahmani et al. (2018); Islas-Cota et al. (2022)
Intelligent Internet of Health Things (IoHT)	Remote real-time tracking of user health and fitness data (e.g., activity levels, heart rate, sleep patterns), self-management wellness monitoring and prevention, telemedicine	Adeniyi et al. (2021); Javed et al. (2020); Whig et al. (2022); Zaman et al. (2022)
Ambient assisted living	Assist dwellers in their daily living activities by customizing indoor comfort management in retirement residence or elderly private home (e.g., DOMUS – domestic ontology managed ubiquitous system).	Cicirelli et al. (2021); Spoladore et al. (2022)
Driver-assistance system	Increase street safety by assisting drivers to drive more safely through recognizing driver's upcoming actions or when the driver is sleepy (e.g., driver's intent project or artificial co-driver project at MIT, in-vehicle ambient intelligent transport systems (I-VAITS) architecture in smart cars)	Rakotonirainy and Tay (2004); Rawlley and Gupta (2023)

security." Our discussion on UAmI has both conceptual elements (i.e., variation of AI) and technical application (i.e., smart technologies).

Interestingly, some of the foundational ideas underlying UAmI have been around for a few decades (Cook et al., 2009; Raffler, 2006). The background of UAmI can be traced back to the early 2000s with the introduction of the concept of ambient intelligence (AmI) by the European Union's Information Society Technologies Advisory Group (ISTAG) in 2003 (Ducatel et al., 2003). UAmI is a further advancement of AmI, incorporating ubiquitous computing to offer omnipresent features of perceptual and predictive intelligence through pervasive context awareness (Cook et al., 2009). Simple applications of these ideas exist in, for instance, Grammarly's provision of meaningful alternative formulations of sentences, Gmail's recommendations of other persons whom you may want to include in an e-mail's recipients, entertainment-streaming platforms providing recommendations (e.g., new artists you might like) to improve user experience based on revealed patterns of preferences (e.g., genres, epochs) among other users on the platform (unknown to you) who have similar preference profiles. While these developments are exciting, they require discrete interactions with specific tools, applications, or platforms to benefit from the AI-enabled functionalities (e.g., logging into ChatGPT). UAmI, on the other hand, integrates different solutions seamlessly into a decisional context. Accordingly, our treatment here is particularly timely. Table 18.3 presents some key UAmI tools and their corresponding functionalities.

Conceptual Underpinnings and Applications of UAmI

Humans have an inherent upper limit to the information we can process (Li et al., 2022; Marois & Ivanoff, 2005). Yet, while our inherent information-processing capacity is reaching its asymptotic limits, our informational environment is, as previously noted, evolving at an exponential pace. To manage this gap, strategic leaders need to find commensurate ways of augmenting their information-processing capacity. Several concepts and applications, most drawing on AI, have arisen to help human decision-makers cope. More broadly, smart tech-

nologies (sometimes also referred to as intelligent computing; Schuster, 2007) have started to feature in the debate on paradoxes in the 4IR. Gastaldi et al. (2022, p. 1), for instance, note that adoption of smart technologies can help companies deal with paradoxes of exploration and exploitation and "be efficient and competitive in the short term, as well as flexible and innovative in the long term." Of these technological concepts, we particularly draw attention to UAmI, which we explore in relation to its potential to assist in the information-processing capacity of strategic leaders – a key necessary condition, we argue, for reconciling paradoxes of exploration and exploitation.

Bick and Kummer (2008, p. 79) note that UAmI is characterized by "intelligent, pervasive and unobtrusive computer systems embedded into human environments, tailored to the individual's context-aware needs." As a technological concept, UAmI entails "the ability to continuously and unobtrusively monitor and understand actions in physical environments" (Martinez-Martin et al., 2021, p. e115), by effectively embedding humans in a digital environment that supports people in their day-to-day lives unobtrusively (Raffler, 2006). The idea is that UAmI "will allow people to be surrounded by an artificial environment that assists them proactively" (Augusto, 2007, p. 213). Importantly, we are only now reaching the point where we have scalable supporting infrastructure: interconnecting ubiquitous computing capacity, sensors, and networks with human–computer interfaces (Augusto, 2007).

UAmI applications and interfaces

For strategic leaders, UAmI thus transforms decision-makers from consumers of information to participants in a more symbiotic relationship with omnipresent intelligence (Adeniyi et al., 2021; Awotunde et al., 2022). The tangible interfaces for interacting with UAmI may be wearable technology, portable devices, virtual assistants, accentuated/virtual reality, or even holo-advisors. In its extreme form, it makes the distinction between physical and AI environments indistinguishable (e.g., the metaverse). However, more palatable applications already exist in fairly simple and unobtrusive ways – for instance, through predictive texts when writing an e-mail or conducting a web engine search. Google, for instance, estimates that, given the pervasiveness of human searching for information, simple predictive autocomplete saves about 200 years of typing per day (Sullivan, 2018). Voice-recognition AI technologies, such as Google's Alexa, Samsung's Bixby, and Apple's Siri, are seamlessly integrated into our mobile devices (including smart watches) and sensors in our homes and offices to provide on-demand insights. These advances can help machines execute human commands with greater efficiency.

In more high-profile applications, predictive intelligence builds on sensors and human-equipped learning to help self-driving cars swiftly predict scenarios at more accurate weightings than humans could possibly handle (Hong et al., 2020, 2021). The recent rise of generative AI models that are built on large-scale, deep-learning models (big datasets in machine learning, e.g., text and images), such as ChatGPT, GitHub Copilot, DALL·E 2, GPT-3, Stable Diffusion, have spawned computer creativity forms such as creating art, composing music, writing programming codes and generating complex (scientific) text. This has caused a stir in academic and industry communities since such models present both potential benefits (e.g., assistive intelligence and guidance) and challenges (i.e., they disrupt traditional human ways of organizing and could pose ethical issues), thereby requiring business leaders to rethink and even redesign many of our business systems (Agrawal et al., 2022).

UAmI's interdependence with other key technological concepts

Tangibly, UAmI is also relevant for navigating the IoT, where IoT is an umbrella term for "heterogeneously connected devices that will further extend the borders of the world with physical entities and virtual components" (Li et al., 2015, p. 243). Thus, our discussion is timely, as by 2025, there will be 75 billion IoT devices in the world.[4] Intuitive applications have already emerged in areas where human capacity to cover spatial requirements is limited, such as smart homes (see Choi et al., 2021; Li et al., 2021) and smart healthcare facilities (Dunne et al., 2021). In these settings, physical environments are calibrated through information shared between interconnected devices such as helium networks (Haleem et al., 2018), which are decentralized networks of long-range wireless hotspots that exclude the need for traditional mobile-network subscriptions (Rawat et al., 2020). Such settings boost information-processing performance through faster response time due to the decentralized processing that helps reduce communication latency from centralized data centers.

While the IoT is the interconnectedness between devices that "is able to interact without human intervention" (Li et al., 2015, p. 243), UAmI is how human decision-makers interface with the IoT. To a large extent, because the IoT can handle preset personalized preferences (akin to a thermostat), it may create and reinforce confirmation biases regarding information content. For strategic leaders, these self-reinforcing preferences can be ill-favored and unsettling as they make the leaders become more insular over time. The predictive intelligence offered by the interface of the IoT and UAmI helps mitigate the issues of confirmation biases through a more symbiotic interaction between the human operators (e.g., strategic leaders) and the assistive technologies designed to resolve strategic problems affecting creativity, such as paradoxes of exploration and exploitation.

AI or data-driven projects such as the SPARSE project (Vale et al., 1997) and, more recently, the SCADA alarms (Andrade et al., 2022), are concrete examples of the predictive intelligence applications that consider both user preferences and context awareness. They enable intelligence that accounts for patterns of expressed and latent preferences of users, providing suggestions that are consistent with a user's choice set. Besides having the ability to spot and restore incidents through preset conditions, these two projects develop systems that are more sensitive to transient and ongoing situations and pinpoint alternative anomalies beyond the normally suggested alerts that result from preset conditions. In another instance, advanced AI models with strategic reasoning deployment have even demonstrated the ability to debate with humans (Slonim et al., 2021).

Although we have illustrated some applications of UAmI specific to our focus here, we push the conversation further concerning UAmI's benefits for enhancing capacity to process new information (and thus potentially help strategic leaders reconcile paradoxes of exploration and exploitation).

UAmI and Information Processing in the 4IR: Shifting Towards Transitioning and Synergizing Quadrants

Recall that information processing is grounded in several sub-processes (with allied activities) – notably acquisition (e.g., recognizing, identifying, securing), exchanging (e.g., sharing, transferring, interpreting), and application (e.g., integrating, embedding, encoding solving/solutions) – through which strategic leaders make sense of their informational environment. The burden of each of these activities for strategic leaders is visible in the work entailed by their

Table 18.4 Interaction between UAmI and information-processing sub-processes

	Acquisition	Exchange	Application	Potential Strategic Leadership Benefit in the 4IR
Increasing velocity	Medium-high	High	Low-medium	Minimizing redundancies in informational exchange
Complexity of scope	Low-medium	Medium-high	High	Minimizing knowledge specification constraints and allowing for exposure to greater possible number of combinations between depth and breadth
System interconnectedness	High	Low-medium	Medium-high	Early warning system and revealing of blind spots

sub-processes. In large part, these activities consume (or even deplete) the finite resources of strategic leaders (e.g., time, energy), given their bounded rationality (Schmeichel et al., 2003). A factor opposed to the premise that UAmI could assist strategic leaders process the informational environment and free up human capacity to focus on creative solutions to paradoxes is the need for leaders to take into account the specific nuances of the information environment of the 4IR discussed previously (i.e., velocity, scope, and interconnectedness). Each of these three nuances of the 4IR information environment is applicable to the "transitioning" and "synergizing" quadrants in Figure 18.1 and will have an impact on the information-processing mechanisms that are summarized in Table 18.4.

Alleviating burden of velocity

Information is produced much faster than the human brain can digest it in the 4IR (Li et al., 2022). UAmI allows for increased endurance in Red Queen type of informational settings (Derfus et al., 2008; Voelpel et al., 2005). Traditionally, as a strategy to cope with information overload, humans often end up recirculating shared information (Van Ginkel & Van Knippenberg, 2008). However, this strategy may become less useful, even harmful, in the high-velocity information environment as effective information-processing mechanisms require sharing of non-redundant and diverse insights. As such, it will become much more challenging to obtain non-redundant and relevant information that can be purposively shared if we only rely on our human tendencies. Today, in practice, strategic leaders may deal with partly (in)correct and missing information. In the 4IR, UAmI provides the ability to combine data gathered from many diverse sensorial sources to produce more accurate, comprehensive, and timely information than the scattered pieces of information gathered in the traditional setting. Currently available data mining/automation tools such as DataRobot, BigML, or Azure ML[5] have the ability to assist strategic leaders to acquire, exchange, and apply the information much faster. These AI-enabled solutions represent some promising, albeit discrete, possible base components of UAmI for strategic leaders. We thus speculate that UAmI may be particularly relevant for increasing velocity of information processing, minimizing informational redundancies, and improving information accuracy.

Predictive interpretation of new scope

UAmI may especially help strategic leaders to find new relevant combinations and solutions by identifying uniquely applicable solutions among both old and new knowledge elements that

may evade the processing capacity of strategic leaders (e.g., active versus dormant memory). Finding uniquely applicable solutions is important and has long been a challenge for strategic leaders. In particular, the classic "decision-making paradox" would suggest that one can only find solutions to the problems one specifies (Triantaphyllou, 2000; Triantaphyllou & Mann, 1989). Through collection of information coupled with a set of criteria and values, strategic leaders intend to decide on the "best" solution chosen from possible alternatives. However, this requires up-front knowledge of the solution sought – which makes it difficult to find a unique innovative solution. In the 4IR, the broadening scope of information, criteria, alternatives, and values impedes strategic leaders' efforts to make decisions that may be uniquely applicable. UAmI allows for the relaxing of preset informational specifications or criteria and allows strategic leaders to explore new (or multiple) combinations that may otherwise have evaded them (see also Oehmichen, Schult et al., 2023) and implement their strategic vision (Kavadis et al., 2020). In particular, as the system interfaces with the human operator and understands their (changing) preferences, it can provide increasingly accurate recommendations based on unconventional depth and breadth combinations. To manage the complexity of the scope, open-sourced cloud platforms that use machine-learning and data-mining algorithms, such as ClowdFlows,[6] may help strategic leaders develop a coherent and interactive workflow that is also accessible and executable from anywhere. Thus, we speculate that UAmI can provide strategic leaders with predictive recommendations on alternative ways that informational depth and breadth could be uniquely employed to address exploration–exploitation paradoxes.

Revealing blind spots in hyper-interconnected systems

While the hyper-interconnected system enabled by the IoT provides many benefits, it also exposes strategic leaders on an undefined and infinite number of new flanks. That is, hyper-connectivity creates new blind spots for strategic leaders, which may particularly limit acquisition of relevant information. When overwhelmed by information, decision-makers may become more susceptible to confirmation bias that reinforces competitive blind spots (König et al., 2012; Ng et al., 2009). As a result, strategic leaders may fail to recognize "weak signals," such as emerging disruptive innovations that require adaptive solutions (Eggers & Park, 2018). In this respect, a software framework called FAERIE that supports the development of UAmI applications is relevant, as its applications are designed around the "definition of sets of interconnected activities involving different actors" (Fernández-de-Alba et al., 2014, p. 1876). As such, we speculate that UAmI may be particularly relevant for *acquisition* of information from areas that would have been usually overlooked by boundedly rational strategic leaders, serving as the proverbial "canary in a coal mine" or tsunami warning.

Together, these considerations open up exciting theoretical discussion and new opportunities for research.

DISCUSSION AND FUTURE RESEARCH

The 4IR is characterized by fundamental changes in the informational environment – exponential velocity, complex scope, and hyper-interconnectedness. The shift in this informational environment will require strategic leaders to revamp their approaches to acquire, exchange, and apply information for reconciling exploration–exploitation paradoxical tensions. In this chapter, we explore how new technological concepts of particular interest, such as UAmI can

affect how strategic leaders reconcile such tensions in the 4IR, notably by potentially increasing their information-processing capacity. Can UAmI support the information-processing capacity of our strategic leaders to help reconcile paradoxes of exploration and exploitation in the 4IR?

UAmI represents an important next step in how decision-makers navigate the 4IR – notably, by moving the conversation from discrete AI-enabled solutions as a "thing," to AI "all around us." Our examination postulates that UAmI could be a promising way to help address some of the information-processing limitations faced by strategic leaders. Nevertheless, while UAmI is promising, it is not the proverbial silver bullet, as it may also foster the spread of misinformation if the underlying AIs are biased and/or prone to misinformation. Nevertheless, we have highlighted some first considerations about which sub-processes of information- processing capacity may particularly benefit from the strategic leader–UAmI interaction.

Overall, although the changing information environment in the 4IR exposes strategic leaders to emerging challenges for resolving exploration and exploitation compared to the traditional context, it can also be considered as a promising moment for advancement of new strategic approaches to information processing. We summarize the shift from the traditional to the 4IR context in Figure 18.2. We envision that strategic leaders in the 4IR will still take a central role in harnessing, filtering, and making sense of information. In the individual domain of intelligence (transitioning), a leader's vision and cognition are key to bringing information into effective strategic planning. In the group domain of intelligence (synergizing), we contemplate a few emerging developments regarding structure, culture, and practice. Compared to the traditional organizational structure, the 4IR structure will be more fluid, with collective and decentralized ownership such as DAOs (Singh & Kim, 2019; Wang et al., 2019) and ambient organization (Bjørn-Andersen & Raymond, 2014). This potential change in structure may also

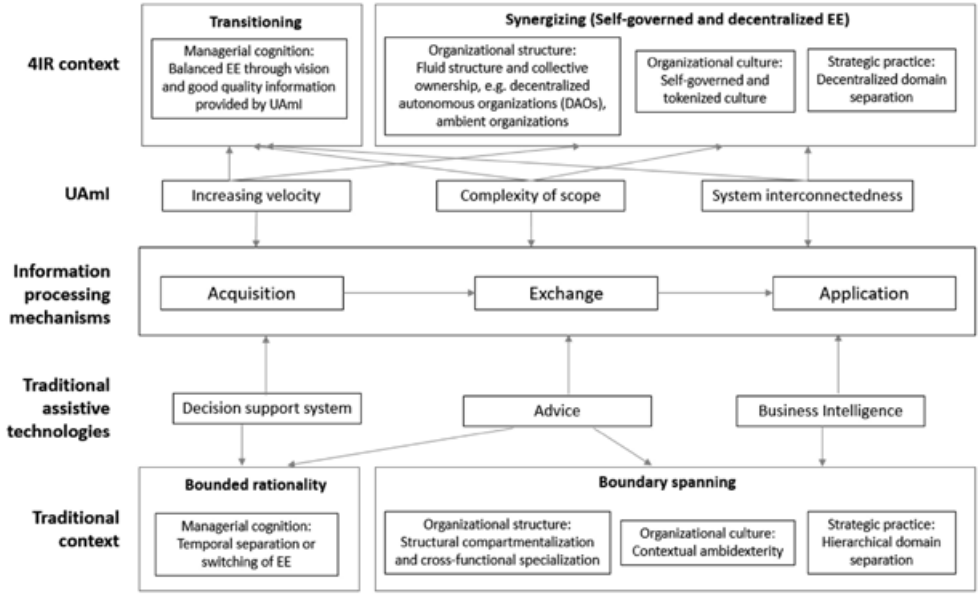

Figure 18.2 Information-processing mechanisms: traditional vs the 4IR

underpin change in organizational culture and strategic practice. As some commentators speculate, the foreseeable cultural situation in DAOs is that there will be more (instead of fewer) leaders to enable self-governance and tokens will be used to align the organizational members' personal and group (e.g., financial) interests.[7] Accordingly, instead of the hierarchical domain separation commonly found in traditional contexts, strategic practice in the 4IR will become more pervasive and decentralized.

Future Research Directions

Against the aforementioned ideas, provocations, and speculations, we offer some suggestions for future research in this area that are categorically based on the four strategic domains where exploration–exploitation paradoxes can be reconciled (managerial cognition, organizational structure, organizational culture, and strategic practice). The topics we have touched upon here naturally lend themselves to multi-disciplinary examinations, which we summarize in Table 18.5.

Managerial cognition: neuroscience foundations of strategic leadership and the 4IR

In the managerial cognition strategic domain, it has sufficed, for our purposes, to acknowledge that the upper limits of information processing by humans exist (Marois & Ivanoff, 2005). However, humans vary not only in their information-processing capacity but also in the approaches they use to process information (Li et al., 2022). Although a thorough discussion on the neuroscience interpretation of information processes is outside the scope of this current treatment, there is a rich discussion on models of information processing, such as parallel and sequential approaches (Sigman & Dehaene, 2008). Strategic leadership literature, more generally, has only started to embrace insights from neuroscience (Boone et al., 2022; Laureiro-Martínez et al., 2015). We believe this pairing will be essential as we further theorize about how smart assistive technologies, such as UAmI, can interface as substitutes or complement our inherent human cognitive capacity (Van Doorn et al., 2022). A particularly intriguing possibility is the role that unpacking insights from affective neuroscience may play in understanding how emotions and cognition interact with UAmI in the 4IR (Compton, 2003; Davidson et al., 2000; Panksepp, 2004). Our work here provides a platform for spearheading these discussions.

Several boundary conditions are still ripe for examination. At a higher level, we also consider that UAmI can be embedded in strategic leaders' information-processing mechanisms in two main streams: enhancing and augmenting. In the first stream of enhancing, UAmI can provide automated types of review for strategic leaders' routines (e.g., information that is embedded in daily activities, traditionally exploitation oriented). Meanwhile, in the second stream of augmenting, UAmI can be used to stimulate creative thinking through information that is incidental to the tasks at hand (traditionally, exploration oriented).

Organizational structure: rethinking upper echelons' involvement in strategy processes in the 4IR

Structurally, our focus in this chapter is on strategic leaders at the top management level (Oehmichen, Weck et al., 2023). However, further research in strategy process is needed to investigate the role of middle and front-line managers in helping top managers to reconcile exploration–exploitation tensions in practice (Greven et al., 2023; Mom et al., 2015; Vaz et

Table 18.5 Future research directions

Strategic Domain	Guiding Questions	Potential Contributions	Themes and Perspectives
Managerial cognition: neuroscience foundations of strategic leadership and the 4IR	How do assistive smart technologies affect our inherent human cognitive capacity?	Integrate serial and parallel processor models of human brain with UAmI input How intelligence needs to be packaged/categorized for improved neuro-processing How creativity, emotions, and intelligence interact in the 4IR	Cognitive neuroscience (Boone et al., 2022; Laureiro-Martínez et al., 2015); AI (Amabile, 2020; Felten et al., 2019) and affective neuroscience (Compton, 2003; Davidson et al., 2000; Panksepp, 2004)
Organizational structure: rethinking upper echelons involvement in strategy processes in the 4IR	What kind of vertical and horizontal coordination mechanisms are needed to catalyze information processing in the 4IR context?	Open up the black box of the richness of strategic leaders (multi-level managers in a firm) Investigate contextualization of multiple stakeholders to leverage on the interdisciplinarity of stakeholders Explore the role of internal/external stakeholders to the exploration–exploitation and other tensions	Porous bounds of strategic leadership (Van Doorn et al., 2022); role theory (Georgakakis et al., 2022); strategy process (Weiser et al., 2020)
Organizational culture: strategic leadership and adoption of UAmI ambidextrous solutions in the 4IR	How do strategic leaders involve multiple internal and external stakeholders in UAmI adoption?	Understand how UAmI helps reinforce or counteract reluctance to adopt or biases of internal and external stakeholders Understand top-down versus bottom-up processes (locus of tensions between continuity and change) in the TMT–technology imbrication Recognize organizational culture that reinforces endogenous and exogenous drivers of adoption	Strategy implementation (Geroski, 2000; Heyden, Fourné et al., 2017; Vaz et al., 2022); stakeholder involvement (Damanpour et al., 2018); TMT–technology imbrication (Leonardi, 2011; López-Muñoz & Escribá-Esteve, 2017); managerial fads (Nicolai et al., 2010)
Strategic practice: sociomateriality and strategic leadership interfaces with UAmI	How will UAmI be materially manifested in strategic practice?	Understanding standards battles for UAmI interfaces Understanding how users make sense of designs, preferences, and providers Understanding supporting system requirements and user experience considerations	Sociomateriality (Cecez-Kecmanovic et al., 2014; Orlikowski, 2010); standards battles (Gallagher, 2012)

al., 2022; Wilden et al., 2023). For instance, what kind of vertical and horizontal coordination mechanisms are needed to catalyze information processing in the 4IR context? We have treated the strategic leadership function as a black box here, but recent advancements highlight the theoretical richness available to conceptualize strategic leaders (Van Doorn et al., 2022). Besides conducting future research on the role of multi-level managers in a firm, it may also be interesting to investigate contextualization of multiple stakeholders. Which internal and external stakeholders should be incorporated to resolve the exploration–exploitation and other organizational tensions? As there are also paradoxical demands of internal and external stakeholders, to what degree can strategic leaders leverage on the interdisciplinarity of stakeholders to reconcile their conflicting interests? Our understanding of how the informational environment of the 4IR is shifting could benefit from an understanding of how the strategic leadership function, itself, is changing (Georgakakis et al., 2022; Krause et al., 2022; Van Doorn et al., 2022).

Organizational culture: strategic leadership and adoption of UAmI

Third, upper echelons theory informs us that the transition to the 4IR will require strategic leaders with characteristics that are open to change and receptive to new technologies. Yet, strategic leadership research has long documented executives' resistance to adoption of radical new technologies and technological concepts (Hambrick et al., 1993; Heyden, Reimer et al., 2017; McClelland et al., 2010). In part, there are innate characteristics of strategic leaders that are associated with more or less propensity to embrace change (Barker & Mueller, 2002). Yet, even well-intended managers may fail to change due to information residing in blind spots. UAmI holds the potential to not only help executives identify new information residing in blind spots but also help with the reliable interpretation of this information to find integrative solutions that would traditionally have been the source of conflict (Amason & Sapienza, 1997; Mehrabi et al., 2021; Simons & Peterson, 2000). The characteristics of upper echelons, associated with whether UAmI reinforces or counteracts biases in information processing, emerge as an important way to understand the ability and motivation of strategic leaders to reconcile paradoxes of exploration and exploitation. To counteract reluctance to adopt, we foresee that it will be essential to investigate how strategic leaders involve internal and external stakeholders to help them with UAmI adoption (Damanpour et al., 2018; Van Doorn et al., 2022).

A necessary condition for the envisioned promise of UAmI is adoption and diffusion. Upper echelons theory states that strategic choices (such as adoption of new technologies) are influenced by executive characteristics. To fully benefit from technology adoption and to capitalize on its values, there is a need for an interwoven relationship between top management team (TMT) factors (non-technological) and technology (material), referred to as TMT–technology imbrication (Leonardi, 2011; López-Muñoz & Escribá-Esteve, 2017). The literature on models of technology diffusion gives a good overview of endogenous and exogenous drivers of technology diffusion through which strategic leaders interface with UAmI (Geroski, 2000). For instance, as AI tools building on generative pre-trained transformer models (e.g., ChatGPT) gain popularity, it can be expected that they will be incorporated into ubiquitous interfaces. Yet, as these tools diffuse and become embedded in user interfaces such as robo- or holo-advisors, examination of whether UAmI is more than a managerial fad will be essential (Abrahamson, 1991; Nicolai et al., 2010).

Strategic practice: sociomateriality and strategic leadership interfaces with UAmI
Finally, although we have emphasized the conceptual underpinnings and technological intuition of UAmI, an immediate research direction to fully understand its utility is the investigation of how human users will materially interface with UAmI. For instance, wearable technologies, smart devices, virtual reality, and holo-advisors are some potential applications that allow for seamless interaction with UAmI. In this vein, several research traditions may inform our ability to theorize how UAmI may be manifested in strategic practice. The literature on sociomateriality could be an important starting point (Balogun et al., 2014; Cecez-Kecmanovic et al., 2014; Orlikowski, 2010), as it concerns how human actors make sense of their interdependence with technologies and practices in organizational life. Complementing this, is the literature on standards battles (Gallagher, 2012; Van de Kaa & de Vries, 2015), which helps us understand the emergence of dominant standards, operating systems, and user designs through which strategic leaders interface with UAmI. Together, we have invited examination of user designs and material interfaces required for UAmI to become tangibly useful in organizational settings.

CONCLUSION

In this chapter, we hope to have offered several provocations to the literature on strategic leadership and exploration–exploitation, by recasting extant solutions in the context of the 4IR. We have argued that the interface between the most salient human dimension of organizations (leadership) and extreme advances in technology (UAmI) is one of the core opportunities to realize the promise of the 4IR. We have explored the notion that the 4IR creates an overwhelming informational environment for strategic leaders. In exploring possible solutions, we shed light on how UAmI can assist strategic leaders to reconcile paradoxes by relaxing their information-processing demands. Particularly, we have postulated that the ways strategic leaders have traditionally interfaced with the information environment are changing in the 4IR, challenging our dependence on existing solutions to paradoxes in this era. In a world of increasing, immediate, and omnipresent information, UAmI may serve as a key complement to allow our distinctive humanness to thrive.

NOTES

1. 1 exabyte (EB) = 1 billion gigabytes (GB).
2. Top management team.
3. 1 zettabyte (ZB) = 1000 exobytes (EB).
4. Statista (2016). *Internet of Things – number of connected devices worldwide 2015-2025*. Retrieved August 16, 2023 from https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/
5. See, respectively: datarobot.com, bigml.com, https://azure.microsoft.com/en-us/products/machine-learning/.
6. Clowdflows.org.
7. ShapeShift (2022, February 1). *DAO culture*. Medium. https://medium.com/@ShapeShift.com/dao-culture-dfd0040bec69

REFERENCES

Abdolrahmani, A., Kuber, R., & Branham, S. M. (2018). "Siri talks at you": An empirical investigation of voice-activated personal assistant (VAPA) usage by individuals who are blind. In *ASSETS '18: Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 249–258). Association for Computing Machinery.

Abrahamson, E. (1991). Managerial fads and fashions: The diffusion and rejection of innovations. *Academy of Management Review*, *16*(3), 586–612. https://doi.org/10.5465/amr.1991.4279484

Adeniyi, E. A., Ogundokun, R. O., & Awotunde, J. B. (2021). IoMT-based wearable body sensors network healthcare monitoring system. In G. Marques, A. Kumar Bhoi, V. H. C. de Albuquerque & K. S. Hareesha (Eds.), *IoT in healthcare and ambient assisted living* (pp. 103–121). Springer.

Agrawal, A., Gans, J., & Goldfarb, A. (2022, December 12). ChatGPT and how AI disrupts industries. *Harvard Business Review*. https://hbr.org/2022/12/chatgpt-and-how-ai-disrupts-industries

Alexiev, A., Jansen, J. J., Van den Bosch, F. A., & Volberda, H. W. (2010). Top management team advice seeking and exploratory innovation: The moderating role of TMT heterogeneity. *Journal of Management Studies*, *47*(7), 1343–1364. https://doi.org/10.2139/ssrn.1083987

Alexiev, A., Volberda, H., Jansen, J., & Van Den Bosch, F. (2019). Contextualizing senior executive advice seeking: The role of decision process comprehensiveness and empowerment climate. *Organization Studies*, *41*(4). https://doi.org/10.1177/0170840619830128

Amabile, T. M. (2020). Creativity, artificial intelligence, and a world of surprises. *Academy of Management Discoveries*, *6*(3), 351–354. https://doi.org/10.5465/amd.2019.0075

Amason, A. C., & Sapienza, H. J. (1997). The effects of top management team size and interaction norms on cognitive and affective conflict. *Journal of Management*, *23*(4), 495–516. https://doi.org/10.1177/014920639702300401

Andrade, J., Rocha, C., Silva, R., Viana, J., Bessa, R. J., Gouveia, C., Almeida, B., Santos, R., Louro, M., & Santos, P. (2022). Data-driven anomaly detection and event log profiling of SCADA alarms. *IEEE Access*, *10*, 73758–73773. https://doi.org/10.1109/access.2022.3190398

Augusto, J. C. (2007). Ambient intelligence: The confluence of ubiquitous/pervasive computing and artificial intelligence. In A. J. Schuster (Ed.), *Intelligent computing everywhere* (pp. 213–234). Springer.

Awotunde, J. B., Jimoh, R. G., AbdulRaheem, M., Oladipo, I. D., Folorunso, S. O., & Ajamu, G. J. (2022). IoT-based wearable body sensor network for COVID-19 pandemic. In A.-E. Hassanien, S. M. Elghamrawy & I. Zelinka (Eds.), *Advances in data science and intelligent data communication technologies for COVID-19* (pp. 253–275). Springer.

Bag, S., & Wood, L. C. (2022). Guest editorial: Human resource development in the digital age: Recent issues and future research directions. *International Journal of Manpower*, *43*(2), 253–262. https://doi.org/10.1108/ijm-05-2022-561

Balogun, J., Jacobs, C., Jarzabkowski, P., Mantere, S., & Vaara, E. (2014). Placing strategy discourse in context: Sociomateriality, sensemaking, and power. *Journal of Management Studies*, *51*(2), 175–201. https://doi.org/10.1111/joms.12059

Barker, V. L., & Mueller, G. C. (2002). CEO characteristics and firm R&D spending. *Management Science*, *48*(6), 782–801. https://doi.org/10.1287/mnsc.48.6.782.187

Bechtoldt, M. N., De Dreu, C. K., Nijstad, B. A., & Choi, H.-S. (2010). Motivated information processing, social tuning, and group creativity. *Journal of Personality and Social Psychology*, *99*(4), 622–637. https://doi.org/10.1037/a0019386

Benner, M. J., & Tushman, M. L. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review*, *28*(2), 238–256. https://doi.org/10.2307/30040711

Bick, M., & Kummer, T.-F. (2008). Ambient intelligence and ubiquitous computing. In H. H. Adelsberger, Kinshuk, J. M. Pawlowski & D. G. Sampson (Eds.), *Handbook on information technologies for education and training* (pp. 79–100). Springer.

Bjørn-Andersen, N., & Raymond, B. (2014). The impact of IT over five decades – towards the ambient organization. *Applied Ergonomics*, *45*(2), 188–197. https://doi.org/10.1016/j.apergo.2013.04.025

Boone, C., Buyl, T., Declerck, C. H., & Sajko, M. (2022). A neuroscience-based model of why and when CEO social values affect investments in corporate social responsibility. *The Leadership Quarterly*, *33*(3), Article 101386. https://doi.org/10.1016/j.leaqua.2020.101386

Cecez-Kecmanovic, D., Galliers, R. D., Henfridsson, O., Newell, S., & Vidgen, R. (2014). The sociomateriality of information systems. *MIS Quarterly*, *38*(3), 809–830. http://doi.org/10.25300/MISQ/2014/38:3.3

Choi, W., Kim, J., Lee, S., & Park, E. (2021). Smart home and internet of things: A bibliometric study. *Journal of Cleaner Production*, *301*, Article 126908. https://doi.org/10.1016/j.jclepro.2021.126908

Cicirelli, G., Marani, R., Petitti, A., Milella, A., & D'Orazio, T. (2021). Ambient assisted living: A review of technologies, methodologies and future perspectives for healthy aging of population. *Sensors*, *21*(10), 3549. https://doi.org/10.3390/s21103549

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D. *The Economic Journal*, *99*(397), 569–596. http://doi.org/10.2307/2233763

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152. http://doi.org/10.2307/2393553

Compton, R. J. (2003). The interface between emotion and attention: A review of evidence from psychology and neuroscience. *Behavioral and Cognitive Neuroscience Reviews*, *2*(2), 115–129. https://doi.org/10.1177/1534582303002002003

Conway, E., & Monks, K. (2011). Change from below: The role of middle managers in mediating paradoxical change. *Human Resource Management Journal*, *21*(2), 190–203. https://doi.org/10.1111/j.1748-8583.2010.00135.x

Cook, D. J., Augusto, J. C., & Jakkula, V. R. (2009). Ambient intelligence: Technologies, applications, and opportunities. *Pervasive and Mobile Computing*, *5*(4), 277–298. https://doi.org/10.1016/j.pmcj.2009.04.001

Damanpour, F., Sanchez-Henriquez, F., & Chiu, H. H. (2018). Internal and external sources and the adoption of innovations in organizations. *British Journal of Management*, *29*(4), 712–730. https://doi.org/10.1111/1467-8551.12296

Davidson, R. J., Jackson, D. C., & Kalin, N. H. (2000). Emotion, plasticity, context, and regulation: Perspectives from affective neuroscience. *Psychological Bulletin*, *126*(6), 890–909. https://doi.org/10.1037/0033-2909.126.6.890

De Dreu, C. K., Nijstad, B. A., Bechtoldt, M. N., & Baas, M. (2011). Group creativity and innovation: A motivated information processing perspective. *Psychology of Aesthetics, Creativity, and the Arts*, *5*(1), 81–89. https://doi.org/10.1037/a0017986

Derfus, P. J., Maggitti, P. G., Grimm, C. M., & Smith, K. G. (2008). The red queen effect: Competitive actions and firm performance. *Academy of Management Journal*, *51*(1), 61–80. https://doi.org/10.5465/amj.2008.30708624

Desjardins, J. (2019, April 17). *How much data is generated each day?* World Economic Forum. https://www.weforum.org/agenda/2019/04/how-much-data-is-generated-each-day-cf4bddf29f/

Dieste, M., Sauer, P. C., & Orzes, G. (2022). Organizational tensions in industry 4.0 implementation: A paradox theory approach. *International Journal of Production Economics*, *251*, Article 108532. https://doi.org/10.1016/j.ijpe.2022.108532

Ducatel, K., Bogdanowicz, M., Scapolo, F., Leijten, J., & Burgelman, J.-C. (2003). *Ambient intelligence: From vision to reality* (IST Advisory Group draft report). European Commission.

Dunne, R., Morris, T., & Harper, S. (2021). A survey of ambient intelligence. *ACM Computing Surveys (CSUR)*, *54*(4), 1–27. https://doi.org/10.1145/3447242

Eggers, J., & Park, K. F. (2018). Incumbent adaptation to technological change: The past, present, and future of research on heterogeneous incumbent response. *Academy of Management Annals*, *12*(1), 357–389. https://doi.org/10.5465/annals.2016.0051

Felten, E., Raj, M., & Seamans, R. C. (2019). The effect of artificial intelligence on human labor: An ability-based approach. *Academy of Management Proceedings*, *2019*(1), Article 15784. https://doi.org/10.5465/ambpp.2019.140

Fernández-de-Alba, J. M., Campillo, P., Fuentes-Fernandez, R., & Pavon, J. (2014). Opportunistic control mechanisms for ambience intelligence worlds. *Expert Systems with Applications*, *41*(4), 1875–1884. https://doi.org/10.1016/j.eswa.2013.08.084

Ferreras-Méndez, J. L., Newell, S., Fernández-Mesa, A., & Alegre, J. (2015). Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity. *Industrial Marketing Management*, *47*, 86–97. https://doi.org/10.1016/j.indmarman.2015.02.038

Foege, J. N., Lauritzen, G. D., Tietze, F., & Salge, T. O. (2019). Reconceptualizing the paradox of openness: How solvers navigate sharing-protecting tensions in crowdsourcing. *Research Policy*, *48*(6), 1323–1339. https://doi.org/10.1016/j.respol.2019.01.013

Fourné, S. P., Rosenbusch, N., Heyden, M. L., & Jansen, J. J. (2019). Structural and contextual approaches to ambidexterity: A meta-analysis of organizational and environmental contingencies. *European Management Journal*, *37*(5), 564–576. https://doi.org/10.1016/j.emj.2019.04.002

Gallagher, S. R. (2012). The battle of the blue laser DVDs: The significance of corporate strategy in standards battles. *Technovation*, *32*(2), 90–98. https://doi.org/10.1016/j.technovation.2011.10.004

Gastaldi, L., Lessanibahri, S., Tedaldi, G., & Miragliotta, G. (2022). Companies' adoption of Smart Technologies to achieve structural ambidexterity: An analysis with SEM. *Technological Forecasting and Social Change*, *174*, Article 121187. https://doi.org/10.1016/j.techfore.2021.121187

Georgakakis, D., Heyden, M. L., Oehmichen, J. D., & Ekanayake, U. I. (2022). Four decades of CEO–TMT interface research: A review inspired by role theory. *The Leadership Quarterly*, *33*(3), Article 101354. https://doi.org/10.1016/j.leaqua.2019.101354

Geroski, P. A. (2000). Models of technology diffusion. *Research Policy*, *29*(4–5), 603–625. https://doi.org/10.1016/s0048-7333(99)00092-x

Gibson, C. B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, *47*(2), 209–226. https://www.jstor.org/stable/20159573

Gielnik, M. M., Frese, M., Graf, J. M., & Kampschulte, A. (2012). Creativity in the opportunity identification process and the moderating effect of diversity of information. *Journal of Business Venturing*, *27*(5), 559–576. https://doi.org/10.1016/j.jbusvent.2011.10.003

Greven, A., Kruse, S., Vos, A., Strese, S., & Brettel, M. (2023). Achieving product ambidexterity in new product development: The role of middle managers' dynamic managerial capabilities. *Journal of Management Studies*, *60*(7), 1786–1818. https://doi.org/10.1111/joms.12886

Haleem, A., Allen, A., Thompson, A., Nijdam, M., & Garg, R. (2018). *Helium: A decentralized wireless network*. https://s3-us-west-2.amazonaws.com/helium-media/whitepaper.pdf

Hambrick, D. C., Geletkanycz, M. A., & Fredrickson, J. W. (1993). Top executive commitment to the status quo: Some tests of its determinants. *Strategic Management Journal*, *14*(6), 401–418. https://doi.org/10.1002/smj.4250140602

Hanisch, M., Goldsby, C. M., Fabian, N. E., & Oehmichen, J. (2023). Digital governance: A conceptual framework and research agenda. *Journal of Business Research*, *162*, Article 113777. https://doi.org/10.1016/j.jbusres.2023.113777

Heyden, M. L., Fourné, S. P., Koene, B. A., Werkman, R., & Ansari, S. S. (2017). Rethinking "top-down" and "bottom-up" roles of top and middle managers in organizational change: Implications for employee support. *Journal of Management Studies*, *54*(7), 961–985. https://doi.org/10.1111/joms.12258

Heyden, M. L., Reimer, M., & Van Doorn, S. (2017). Innovating beyond the horizon: CEO career horizon, top management composition, and R&D intensity. *Human Resource Management*, *56*(2), 205–224. https://doi.org/10.1002/hrm.21730

Heyden, M. L., Van Doorn, S., Reimer, M., Van Den Bosch, F. A., & Volberda, H. W. (2013). Perceived environmental dynamism, relative competitive performance, and top management team heterogeneity: Examining correlates of upper echelons' advice-seeking. *Organization Studies*, *34*(9), 1327–1356. https://doi.org/10.1177/0170840612470229

Hong, J.-W., Cruz, I., & Williams, D. (2021). AI, you can drive my car: How we evaluate human drivers vs self-driving cars. *Computers in Human Behavior*, *125*, Article 106944. https://doi.org/10.1016/j.chb.2021.106944

Hong, J.-W., Wang, Y., & Lanz, P. (2020). Why is artificial intelligence blamed more? Analysis of faulting artificial intelligence for self-driving car accidents in experimental settings. *International Journal of Human–Computer Interaction*, *36*(18), 1768–1774. https://doi.org/10.1080/10447318.2020.1785693

Islas-Cota, E., Gutierrez-Garcia, J. O., Acosta, C. O., & Rodríguez, L.-F. (2022). A systematic review of intelligent assistants. *Future Generation Computer Systems*, *128*, 45–62. https://doi.org/10.1016/j.future.2021.09.035

Jansen, J. J., Simsek, Z., & Cao, Q. (2012). Ambidexterity and performance in multiunit contexts: Cross-level moderating effects of structural and resource attributes. *Strategic Management Journal*, *33*(11), 1286–1303. https://doi.org/10.1002/smj.1977

Jansen, J. J., Tempelaar, M. P., Van den Bosch, F. A., & Volberda, H. W. (2009). Structural differentiation and ambidexterity: The mediating role of integration mechanisms. *Organization Science*, *20*(4), 797–811. https://doi.org/10.1287/orsc.1080.0415

Jarzabkowski, P., & Balogun, J. (2009). The practice and process of delivering integration through strategic planning. *Journal of Management Studies*, *46*(8), 1255–1288. https://doi.org/10.1111/j.1467-6486.2009.00853.x

Javed, A. R., Sarwar, M. U., Beg, M. O., Asim, M., Baker, T., & Tawfik, H. (2020). A collaborative healthcare framework for shared healthcare plan with ambient intelligence. *Human-centric Computing and Information Sciences*, *10*, 1–21. https://doi.org/10.1186/s13673-020-00245-7

Junni, P., Sarala, R. M., Taras, V., & Tarba, S. Y. (2013). Organizational ambidexterity and performance: A meta-analysis. *The Academy of Management Perspectives*, *27*(4), 299–312. https://doi.org/10.5465/amp.2012.0015

Kämmer, J. E., Choshen-Hillel, S., Müller-Trede, J., Black, S. L., & Weibler, J. (2023). A systematic review of empirical studies on advice-based decisions in behavioral and organizational research. *Decision*, *10*(2), 107–137. https://doi.org/10.1037/dec0000199

Kavadis, N., Heyden, M. L., & Sidhu, J. S. (2020). Fresh in the saddle: The influence of a new CEO's vision and origin, and CEO succession type on market actors' reactions. *Long Range Planning*, *55*(2), Article 102050. https://doi.org/10.1016/j.lrp.2020.102050

Kim, C., Song, J., & Nerkar, A. (2012). Learning and innovation: Exploitation and exploration trade-offs. *Journal of Business Research*, *65*(8), 1189–1194. https://doi.org/10.1016/j.jbusres.2011.07.006

Knight, E., Daymond, J., & Paroutis, S. (2020). Design-led strategy: How to bring design thinking into the art of strategic management. *California Management Review*, *62*(2), 30–52. https://doi.org/10.1177/0008125619897594

Knight, E., & Paroutis, S. (2017). Becoming salient: The TMT leader's role in shaping the interpretive context of paradoxical tensions. *Organization Studies*, *38*(3–4), 403–432. https://doi.org/10.1177/0170840616640844

Kobarg, S., Stumpf-Wollersheim, J., & Welpe, I. M. (2019). More is not always better: Effects of collaboration breadth and depth on radical and incremental innovation performance at the project level. *Research Policy*, *48*(1), 1–10. https://doi.org/10.1016/j.respol.2018.07.014

König, A., Schulte, M., & Enders, A. (2012). Inertia in response to non-paradigmatic change: The case of meta-organizations. *Research Policy*, *41*(8), 1325–1343. https://doi.org/10.1016/j.respol.2012.03.006

Kowalczyk, M., & Buxmann, P. (2015). An ambidextrous perspective on business intelligence and analytics support in decision processes: Insights from a multiple case study. *Decision Support Systems*, *80*, 1–13. https://doi.org/10.1016/j.dss.2015.08.010

Krause, R., Roh, J., & Whitler, K. A. (2022). The top management team: Conceptualization, operationalization, and a roadmap for scholarship. *Journal of Management*, *48*(6), 1548–1601. https://doi.org/10.1177/01492063211072459

Laureiro-Martínez, D., Brusoni, S., Canessa, N., & Zollo, M. (2015). Understanding the exploration–exploitation dilemma: An fMRI study of attention control and decision-making performance. *Strategic Management Journal*, *36*(3), 319–338. https://doi.org/10.1002/smj.2221

Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy*, *43*(5), 867–878. https://doi.org/10.1016/j.respol.2013.10.004

Lavie, D., Stettner, U., & Tushman, M. L. (2010). Exploration and exploitation within and across organizations. *The Academy of Management Annals*, *4*(1), 109–155. https://doi.org/10.5465/19416521003691287

Lee, E., & Puranam, P. (2016). The implementation imperative: Why one should implement even imperfect strategies perfectly. *Strategic Management Journal*, *37*(8), 1529–1546. https://doi.org/10.1002/smj.2414

Leonardi, P. M. (2011). When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *MIS Quarterly*, *35*(1), 147–167. https://doi.org/10.2307/23043493

Li, S., Xu, L. D., & Zhao, S. (2015). The internet of things: A survey. *Information Systems Frontiers*, *17*(2), 243–259. https://doi.org/10.1007/s10796-014-9492-7

Li, T., Zheng, Y., Wang, Z., Zhu, D. C., Ren, J., Liu, T., & Friston, K. (2022). Brain information processing capacity modeling. *Scientific Reports*, *12*(1), 2174. https://doi.org/10.1038/s41598-022-05870-z

Li, W., Yigitcanlar, T., Erol, I., & Liu, A. (2021). Motivations, barriers and risks of smart home adoption: From systematic literature review to conceptual framework. *Energy Research & Social Science*, *80*, Article 102211. https://doi.org/10.1016/j.erss.2021.102211

López-Muñoz, J. F., & Escribá-Esteve, A. (2017). An upper echelons perspective on information technology business value. *European Research on Management and Business Economics*, *23*(3), 173–181. https://doi.org/10.1016/j.iedeen.2017.02.003

Lubatkin, M. H., Simsek, Z., Ling, Y., & Veiga, J. F. (2006). Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management*, *32*(5), 646–672. https://doi.org/10.1177/0149206306290712

Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain governance – a new way of organizing collaborations? *Organization Science*, *32*(2), 500–521. https://doi.org/10.1287/orsc.2020.1379

Mahmood, T., & Mubarik, M. S. (2020). Balancing innovation and exploitation in the fourth industrial revolution: Role of intellectual capital and technology absorptive capacity. *Technological Forecasting and Social Change*, *160*, Article 120248. https://doi.org/10.1016/j.techfore.2020.120248

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

Marois, R., & Ivanoff, J. (2005). Capacity limits of information processing in the brain. *Trends in Cognitive Sciences*, *9*(6), 296–305. https://doi.org/10.1016/j.tics.2005.04.010

Martinez-Martin, N., Luo, Z., Kaushal, A., Adeli, E., Haque, A., Kelly, S. S., Wieten, S., Cho, M. K., Magnus, D., Fei-Fei, L., Schulman, K., & Milstein, A. (2021). Ethical issues in using ambient intelligence in health-care settings. *The Lancet Digital Health*, *3*(2), e115–e123. https://doi.org/10.1016/S2589-7500(20)30275-2

Matthew, C. T. (2009). Leader creativity as a predictor of leading change in organizations. *Journal of Applied Social Psychology*, *39*(1), 1–41. https://doi.org/10.1111/j.1559-1816.2008.00427.x

Matthews, L., Heyden, M. L. M., & Zhou, D. (2022). Paradoxical transparency? Capital market responses to exploration and exploitation disclosure. *Research Policy*, *51*(1), Article 104396. https://doi.org/10.1016/j.respol.2021.104396

McClelland, P. L., Liang, X., & Barker, V. L. (2010). CEO commitment to the status quo: Replication and extension using content analysis. *Journal of Management*, *36*(5), 1251–1277. https://doi.org/10.1177/0149206309345019

Mehrabi, H., Coviello, N., & Ranaweera, C. (2021). When is top management team heterogeneity beneficial for product exploration? Understanding the role of institutional pressures. *Journal of Business Research*, *132*, 775–786. https://doi.org/10.1016/j.jbusres.2020.10.057

Menon, T., & Pfeffer, J. (2003). Valuing internal vs external knowledge: Explaining the preference for outsiders. *Management Science*, *49*(4), 497–513. https://doi.org/10.2139/ssrn.369480

Miron-Spektor, E., Ingram, A., Keller, J., Smith, W. K., & Lewis, M. W. (2018). Microfoundations of organizational paradox: The problem is how we think about the problem. *Academy of Management Journal*, *61*(1), 26–45. https://doi.org/10.5465/amj.2016.0594

Mom, T. J. M., Fourné, S. P. L., & Jansen, J. J. P. (2015). Managers' work experience, ambidexterity, and performance: The contingency role of the work context. *Human Resource Management*, *54*(S1), s133–s153. https://doi.org/10.1002/hrm.21663

Mom, T. J., Van Den Bosch, F. A., & Volberda, H. W. (2009). Understanding variation in managers' ambidexterity: Investigating direct and interaction effects of formal structural and personal coordination mechanisms. *Organization Science*, *20*(4), 812–828. https://doi.org/10.1287/orsc.1090.0427

Nadkarni, S., & Barr, P. S. (2008). Environmental context, managerial cognition, and strategic action: An integrated view. *Strategic Management Journal*, *29*(13), 1395–1427. https://doi.org/10.1002/smj.717

Nadkarni, S., Chen, T., & Chen, J. (2016). The clock is ticking! Executive temporal depth, industry velocity, and competitive aggressiveness. *Strategic Management Journal*, *37*(6), 1132–1153. https://doi.org/10.1002/smj.2376

Ng, D., Westgren, R., & Sonka, S. (2009). Competitive blind spots in an institutional field. *Strategic Management Journal*, *30*(4), 349–369. https://doi.org/10.1002/smj.741

Nicolai, A. T., Schulz, A. C., & Thomas, T. W. (2010). What Wall Street wants – exploring the role of security analysts in the evolution and spread of management concepts. *Journal of Management Studies*, *47*(1), 162–189. https://doi.org/10.1111/j.1467-6486.2009.00862.x

Oehmichen, J., Heyden, M. L., Georgakakis, D., & Volberda, H. W. (2017). Boards of directors and organizational ambidexterity in knowledge-intensive firms. *The International Journal of Human Resource Management*, *28*(2), 283–306. https://doi.org/10.1080/09585192.2016.1244904

Oehmichen, J., Schult, A., & Qi Dong, J. (2023). Successfully organizing AI innovation through collaboration with startups. *MIS Quarterly Executive*, *22*(1), Article 4. https://aisel.aisnet.org/misqe/vol22/iss1/4

Oehmichen, J., Weck, M., & Van Ees, H. (2023). Directors' digital expertise and board diversity: Empirical evidence from Dutch boards. In S. Tasheva & M. Huse (Eds.), *Research handbook on diversity and corporate governance* (pp. 82–95). Edward Elgar Publishing.

Orlikowski, W. J. (2010). The sociomateriality of organisational life: Considering technology in management research. *Cambridge Journal of Economics*, *34*(1), 125–141. https://doi.org/10.1093/cje/bep058

Panksepp, J. (2004). *Affective neuroscience: The foundations of human and animal emotions*. Oxford University Press.

Papachroni, A., Heracleous, L., & Paroutis, S. (2015). Organizational ambidexterity through the lens of paradox theory: Building a novel research agenda. *The Journal of Applied Behavioral Science*, *51*(1), 71–93. https://doi.org/10.1177/0021886314553101

Park, Y., Pavlou, P. A., & Saraf, N. (2020). Configurations for achieving organizational ambidexterity with digitization. *Information Systems Research*, *31*(4), 1376–1397. https://doi.org/10.1287/isre.2020.0950

Patel, P. C., Messersmith, J. G., & Lepak, D. P. (2013). Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity. *Academy of Management Journal*, *56*(5), 1420–1442. https://doi.org/10.5465/amj.2011.0255

Puranam, P., Stieglitz, N., Osman, M., & Pillutla, M. M. (2015). Modelling bounded rationality in organizations: Progress and prospects. *The Academy of Management Annals*, *9*(1), 337–392. https://doi.org/10.1080/19416520.2015.1024498

Raffler, H. (2006). Other perspectives on ambient intelligence. *Password Magazine*, *23*, 12–13.

Rakotonirainy, A., & Tay, R. (2004). In-vehicle ambient intelligent transport systems (I-VAITS): Towards an integrated research. In *Proceedings of the 7th International IEEE Conference on Intelligent Transportation Systems* (pp. 648–651). Institute of Electrical and Electronics Engineers.

Rawat, A. S., Rajendran, J., Ramiah, H., & Rana, A. (2020). LoRa (long range) and LoRaWAn technology for IoT applications in COVID-19 pandemic. In *Proceedings of the 2020 International Conference on Advances in Computing, Communication & Materials (ICACCM)* (pp. 419–422). Institute of Electrical and Electronics Engineers.

Rawlley, O., & Gupta, S. (2023). Artificial intelligence-empowered vision-based self driver assistance system for internet of autonomous vehicles. *Transactions on Emerging Telecommunications Technologies*, *34*(2), e4683. https://doi.org/10.1002/ett.4683

Samimi, M., Cortes, A. F., Anderson, M. H., & Herrmann, P. (2022). What is strategic leadership? Developing a framework for future research. *The Leadership Quarterly*, *33*(3), Article 101353. https://doi.org/10.1016/j.leaqua.2019.101353

Schmeichel, B. J., Vohs, K. D., & Baumeister, R. F. (2003). Intellectual performance and ego depletion: Role of the self in logical reasoning and other information processing. *Journal of Personality and Social Psychology*, *85*(1), 33–46. https://doi.org/10.1037/0022-3514.85.1.33

Schuster, A. J. (2007). Intelligent computing everywhere. In A. J. Schuster (Ed.), *Intelligent computing everywhere* (pp. 3–23). Springer.

Schwab, K. (2017). *The fourth industrial revolution*. Currency.

Shin, J., Price, M. H., Wolpert, D. H., Shimao, H., Tracey, B., & Kohler, T. A. (2020). Scale and information-processing thresholds in Holocene social evolution. *Nature Communications*, *11*(1), Article 2394. https://doi.org/10.1038/s41467-020-16035-9

Sidhu, J. S., Heyden, M. L., Volberda, H. W., & Van Den Bosch, F. A. (2020). Experience maketh the mind? Top management teams' experiential background and cognitive search for adaptive solutions. *Industrial and Corporate Change*, *29*(2), 333–350. https://doi.org/10.1093/icc/dtz041

Sigman, M., & Dehaene, S. (2008). Brain mechanisms of serial and parallel processing during dual-task performance. *Journal of Neuroscience*, *28*(30), 7585–7598. https://doi.org/10.1523/jneurosci.0948-08.2008

Simons, T. L., & Peterson, R. S. (2000). Task conflict and relationship conflict in top management teams: The pivotal role of intragroup trust. *Journal of Applied Psychology*, *85*(1), 102–111. https://doi.org/10.1037/0021-9010.85.1.102

Simsek, Z. (2009). Organizational ambidexterity: Towards a multilevel understanding. *Journal of Management Studies*, *46*(4), 597–624. https://doi.org/10.1111/j.1467-6486.2009.00828.x

Simsek, Z., Heavey, C., Veiga, J. F., & Souder, D. (2009). A typology for aligning organizational ambidexterity's conceptualizations, antecedents, and outcomes. *Journal of Management Studies*, *46*(5), 864–894. https://doi.org/10.1111/j.1467-6486.2009.00841.x

Simsek, Z., Vaara, E., Paruchuri, S., Nadkarni, S., & Shaw, J. D. (2019). New ways of seeing big data. *Academy of Management Journal*, *62*(4), 971–978. https://doi.org/10.5465/amj.2019.4004

Singh, M., & Kim, S. (2019). Blockchain technology for decentralized autonomous organizations. In S. Kim, G. Deka & P. Zhang (Eds.), *Advances in computers* (Vol. 115, pp. 115–140). Elsevier.

Slonim, N., Bilu, Y., Alzate, C., Bar-Haim, R., Bogin, B., Bonin, F., Choshen, L., Cohen-Karlik, E., Dankin, L., Edelstein, L., Ein-Dor, L., Friedman-Melamed, R., Gavron, A., Gera, A., Gleize, M., Gretz, S., Gutfreund, D., Halfon, Hershcovitch, D. … Aharaonov, R. (2021). An autonomous debating system. *Nature*, *591*(7850), 379–384. https://doi.org/10.1038/s41586-021-03215-w

Smollan, R. K., & Morrison, R. L. (2019). Office design and organizational change: The influence of communication and organizational culture. *Journal of Organizational Change Management*, *32*(4), 426–440. https://doi.org/10.1108/jocm-03-2018-0076

Spoladore, D., Mahroo, A., Trombetta, A., & Sacco, M. (2022). DOMUS: A domestic ontology managed ubiquitous system. *Journal of Ambient Intelligence and Humanized Computing*, *13*(6), 3037–3052. https://doi.org/10.1007/s12652-021-03138-4

Stubbart, C. I. (1989). Managerial cognition: A missing link in strategic management research. *Journal of Management Studies*, *26*(4), 325–347. https://doi.org/10.1007/s12652-021-03138-4

Sullivan, D. (2018, April 20). *How Google autocomplete works in Search*. Google: The Keyword [Blog]. https://blog.google/products/search/how-google-autocomplete-works-search/

Tekic, A., & Willoughby, K. W. (2020). Configuring intellectual property management strategies in co-creation: A contextual perspective. *Innovation*, *22*(2), 128–159. https://doi.org/10.2139/ssrn.3920945

Tempelaar, M. P., & Rosenkranz, N. A. (2017). Switching hats: The effect of role transition on individual ambidexterity. *Journal of Management*, *45*(4), 1517–1539. https://doi.org/10.1177/0149206317714312

Terjesen, S., & Patel, P. C. (2017). In search of process innovations: The role of search depth, search breadth, and the industry environment. *Journal of Management*, *43*(5), 1421–1446. https://doi.org/10.1177/0149206315575710

Triantaphyllou, E. (2000). *Multi-criteria decision making methods*. Springer.

Triantaphyllou, E., & Mann, S. H. (1989). An examination of the effectiveness of multi-dimensional decision-making methods: A decision-making paradox. *Decision Support Systems*, *5*(3), 303–312. https://doi.org/10.1016/0167-9236(89)90037-7

Trieu, V.-H. (2017). Getting value from business intelligence systems: A review and research agenda. *Decision Support Systems*, *93*, 111–124. https://doi.org/10.1016/j.dss.2016.09.019

Turner, N., Swart, J., & Maylor, H. (2013). Mechanisms for managing ambidexterity: A review and research agenda. *International Journal of Management Reviews*, *15*(3), 317–332. https://doi.org/10.1111/j.1468-2370.2012.00343.x

Tushman, M. L., & O'Reilly, C. A. (1996). The ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, *38*(4), 8–30. https://doi.org/10.2307/41165852

Ullah, A., Zhang, Q., & Ahmed, M. (2021). The influence of intellectual property rights protection on contribution efforts of participants in online crowdsourcing contests. *Computers in Human Behavior*, *123*, Article 106869. https://doi.org/10.1016/j.chb.2021.106869

Vale, Z. A., Machado, A., Fernandes, M. F., & Ramos, C. (1997). Sparse: An intelligent alarm processor and operator assistant. *IEEE Expert*, *12*(3), 86–93. https://doi.org/10.1109/64.590086

Van de Kaa, G., & de Vries, H. J. (2015). Factors for winning format battles: A comparative case study. *Technological Forecasting and Social Change*, *91*, 222–235. https://doi.org/10.1016/j.techfore.2014.02.019

Van Doorn, S., Heyden, M. L., Reimer, M., Buyl, T., & Volberda, H. W. (2022). Internal and external interfaces of the executive suite: Advancing research on the porous bounds of strategic leadership. *Long Range Planning*, *55*(3), Article 102214. https://doi.org/10.1016/j.lrp.2022.102214

Van Doorn, S., Heyden, M. L., & Volberda, H. W. (2017). Enhancing entrepreneurial orientation in dynamic environments: The interplay between top management team advice-seeking and absorptive capacity. *Long Range Planning*, *50*(2), 134–144. https://doi.org/10.1016/j.lrp.2016.06.003

Van Ginkel, W. P., & Van Knippenberg, D. (2008). Group information elaboration and group decision making: The role of shared task representations. *Organizational Behavior and Human Decision Processes*, *105*(1), 82–97. https://doi.org/10.1016/j.obhdp.2007.08.005

Vaz, S. L., Raes, A. M. L., & Heyden, M. L. M. (2022). Realizing implementation through relational exchanges with top managers: The mediating role of middle managers' divergent strategic behavior. *Journal of Management Control*, *33*(1), 81–108. https://doi.org/10.1007/s00187-021-00333-4

Voelpel, S., Leibold, M., Tekie, E., & Von Krogh, G. (2005). Escaping the red queen effect in competitive strategy: Sense-testing business models. *European Management Journal*, *23*(1), 3–49. https://doi.org/10.1016/j.emj.2004.12.008

Volberda, H. W., Baden-Fuller, C., & Van Den Bosch, F. A. (2001). Mastering strategic renewal: Mobilising renewal journeys in multi-unit firms. *Long Range Planning*, *34*(2), 159–178. https://www.academia.edu/15191179/Mastering_Strategic_Renewal

Wadhwa, A., Freitas, I. M. B., & Sarkar, M. B. (2017). The paradox of openness and value protection strategies: Effect of extramural R&D on innovative performance. *Organization Science*, *28*(5), 873–893. https://doi.org/10.1287/orsc.2017.1145

Wang, S., Ding, W., Li, J., Yuan, Y., Ouyang, L., & Wang, F.-Y. (2019). Decentralized autonomous organizations: Concept, model, and applications. *IEEE Transactions on Computational Social Systems*, *6*(5), 870–878. https://doi.org/10.1109/tcss.2019.2938190

Weiser, A.-K., Jarzabkowski, P., & Laamanen, T. (2020). Completing the adaptive turn: An integrative view of strategy implementation. *Academy of Management Annals*, *14*(2), 969–1031. https://doi.org/10.5465/annals.2018.0137

Whig, P., Gupta, K., Jiwani, N., & Velu, A. (2022). Ambient intelligence health services using IOT. In M. R. Mahmood, R. Raja, H. Kaur, S. Kumar & K. Kumar Nagwanshi (Eds.), *Ambient intelligence and Internet of Things: Convergent technologies* (pp. 53–79). Wiley.

Wilden, R., Hohberger, J., Devinney, T. M., & Lavie, D. (2018). Revisiting James March (1991): Whither exploration and exploitation? *Strategic Organization*, *16*(3), 352–369. https://doi.org/10.1177/1476127018765031

Wilden, R., Lin, N., Hohberger, J., & Randhawa, K. (2023). Selecting innovation projects: Do middle and senior managers differ when it comes to radical innovation? *Journal of Management Studies*, *60*(7), 1720–1751. https://doi.org/10.1111/joms.12874

Zaman, U., Imran, Mehmood, F., Iqbal, N., Kim, J., & Ibrahim, M. (2022). Towards secure and intelligent Internet of Health Things: A survey of enabling technologies and applications. *Electronics*, *11*(12), 1893. https://doi.org/10.3390/electronics11121893

Zerella, S., von Treuer, K., & Albrecht, S. L. (2017). The influence of office layout features on employee perception of organizational culture. *Journal of Environmental Psychology*, *54*, 1–10. https://doi.org/10.1016/j.jenvp.2017.08.004