

THE EMPOWERMENT OF ARTIFICIAL INTELLIGENCE IN POST-DIGITAL ORGANIZATIONS: EXPLORING HUMAN INTERACTIONS WITH SUPERVISORY AI

Matthew E. Gladden
Georgetown University
CAICR Research Center
USA

Paweł Fortuna
Katolicki Uniwersytet Lubelski
Poland

Artur Modliński
Uniwersytet Łódzki
Poland

Abstract: *Technology evolves together with humans. Across industrial revolutions, its role has evolved from that of a simple tool used by humans to that of intelligent decision-maker and teammate. In the post-digital era where ongoing advances in artificial intelligence are widely visible, the question arises regarding the extent to which technology will be “upgraded” into roles previously filled by human supervisors, thereby replacing persons in managerial positions. This text aims to delineate how the organizational role of technology has been transformed across decades and the forms that it currently takes within companies, with an eye to the future. We draw on posthuman managerial literature and known cases of organizations where some forms of supervisory artificial intelligence are already used. The text is conceptual-reflective by nature; it seeks to initiate a discussion on the many challenges that humanity will face in connection with the deployment of empowered posthuman agents in companies.*

Keywords: *posthuman management, artificial intelligence, algorithmic management, human-machine interaction.*



INTRODUCTION

Almost two decades have passed since discussion of the involvement of artificial agents in organizational decision-making processes emerged in the scientific literature, with journals such as *Information Technology and Management* and *Computers in Human Behavior* constituting the main centers of reflection in the field. It was Rees and Koehler (2002) who considered genetic algorithms (driven by Darwinian principles) when assessing group decision support systems; while genetic algorithms were previously known, the authors' research largely initiated the scholarly investigation of the impacts of algorithmization and other organizational trends facilitated by artificial intelligence (AI). At almost the same time, Benamati and Lederer (2001) observed the dynamic changes that IT companies faced, as a rapid reshaping of technologies demanded faster decision-making and adaptation to the ever more complex IT environment; as such challenges became increasingly pervasive, some organizations began to involve new kinds of agents (such as algorithms) in making decisions. In turn, Adomavicius et al. (2007) proposed a model for taking technology into account as an equal part of an organization's ecosystem, rather than as an isolated subsystem within the organization. That conceptualization was one of the first in the literature to open the door to a "posthuman" approach in management – one that makes it possible to envision artificial agents as actors that can make decisions and potentially even supervise human workers within an organization. Fairchild (2006), meanwhile, recognized that agents involved in decision management need not be (humanly) embodied, noting that decision-making agents could increasingly be a "something" rather than a "someone"; the author thereby highlighted the possibilities for intelligent software to be adapted for decision-making purposes, to meet organizational needs. More recently, Höddinghaus et al. (2020) have shown that algorithms are already performing leadership functions in organizations. They emphasize, however, that people may view such algorithms in divergent ways. For this reason, it is desirable to formulate models that can suggest what factors may contribute to a higher acceptance of algorithms that perform leadership functions and supervise human beings. The present article seeks to respond to that invitation and the larger discourse developed in such journals across decades, at a time when replacing human managers (or their functions) with AI-facilitated algorithmic systems is no longer just a subject of futurological discussions but already a growing focus of work for technologists and entrepreneurs.

The purpose of the text is to investigate how the position of technology in organizations has changed across industrial revolutions from that of passive support tools for humans to that of active decision-makers and (potentially) supervisors. We thus intend to answer the following research questions:

RQ1: What forms do "human-machine professional interaction" take?

RQ2: How has organizational technology transformed from "simple tools" to "empowered agents"?

RQ3: What forms can (and will) "supervisory technology" take, given the capacities and limitations of human beings and AI-based systems?

We begin our text by referencing the general idea of "empowered technology" that has already appeared in the social space. We then show how artificial intelligence influences the decision-making process and performs some supervisory functions in companies. To explain this, we review the evolution of technology and its progressive advance from "teammate" to

“supervisor.” On this basis, we argue that intelligent technology takes on three main roles in post-digital organizations: the managerial, supervisory, and/or advisory. Finally, we address six challenges for supervisory AI not addressed in earlier research: (1) boundaries, (2) adaptation, (3) self-organization, (4) perspectives, (5) interconnectedness, and (6) dynamics. The main contribution of our article is outlining the evolutionary process of the empowerment of technology, as well as creating a theoretical and reflective foundation for the concept of technology as a supervisor of the human workforce.

REVIEW METHODOLOGY

As this study is conceptual-reflective by nature, we have applied the textual narrative synthesis (TNS) proposed by Popay et al. (2006). TNS offers a solid regime for literature review through adoption of a research protocol, while not imposing quantitative restrictions. Following the suggestions of Xiao and Watson (2017), we constructed our research protocol based on two actions: (1) literature search and evaluation and (2) data extraction and analysis. We describe the details of the protocol in the next subsections.

Keywords Search

In recent years, artificial intelligence and robots have been investigated intensively from multidisciplinary perspectives. On one hand, this helps juxtapose various perspectives, but on the other hand, it limits the possibility of reviewing all papers with such a wide-ranging research protocol. We have thus applied a complex keywords search (by introducing “AND” and “OR”) and provided criteria for exclusion. The keywords used for this research were: (1) ‘AI’ AND ‘boss’, (2) ‘artificial intelligence’ AND ‘boss’, (3) ‘AI’ AND ‘transhumanism’, (4) ‘artificial intelligence’ AND ‘transhumanism’, (5) ‘AI’ AND ‘posthumanism’, and (6) ‘artificial intelligence’ AND ‘posthumanism’.

Inclusion/Exclusion Criteria

The protocol is based on branched exclusion criteria. First, we excluded papers that were not peer-reviewed, as their reliability is low. Second, we rejected papers that were not referring to the concept of supervisory technology. Third, we excluded documents that were not written in English. Finally, we have not included in the final analysis papers that focused on technical aspects of supervisory technology. The procedure for excluding papers consisted of two phases. First, we analyzed titles and abstracts, rejecting papers that did not match our criteria. Second, we read the remaining articles in full, repeating the same exclusion procedure. As our article has a conceptual-reflective nature, we have used cross-reading inclusion.

Database Search

As our manuscript is conceptual-reflective, we employed multi-baseline searching for articles in Web of Science and Scopus. The search results are presented in Table 1.

Table 1. The number of articles found according to keywords search.

	Keywords	Number of articles in Web of Science	Number of articles in Scopus
1	'AI' AND 'boss'	66	7
2	'artificial intelligence' AND 'boss'	47	34
3	'AI' AND 'transhumanism'	37	50
4	'artificial intelligence' AND 'transhumanism'	95	112
5	'AI' AND 'posthumanism'	35	36
6	'artificial intelligence' AND 'posthumanism'	73	66
	Total	353	305
Total number after duplicate articles have been removed			387

In line with the protocol, in the first phase, a selection was made on the basis of titles and abstracts. In the second phase, the entire articles were read and those that did not contribute to the answers to the research questions were removed from the analysis. While reading entire articles, we wrote down such sources cited by authors that (a) answered our research questions (b) but did not appear in the Scopus / Web of Science databases. In this way, we included an additional 8 papers. The number of articles eliminated in each phase is shown in Table 2.

Table 2. The quantifying process of eliminating articles

	Number of papers removed	Number of papers left for further analysis
Initial number of articles		387
Phase 1: Title and abstract	324	63
Phase 2: Full reading	37	26
Cross-reading inclusion	8	34

After a detailed analysis of the literature texts, we organized our conceptual manuscript in such a way that it chronologically responds to our three questions presented in the Introduction. We have enriched the theoretical considerations with data from industry reports.

NON-SCIENTIFIC INQUIRIES INTO WORKERS' OPENNESS TO AI SUPERVISION

Within many industries, artificially intelligent systems already play key roles in gathering and processing data, making decisions, and acting in a way that informs or guides the activity of human workers, and as the role of artificial AI in the workplace continues to grow, the question arises of how human beings will respond emotionally, socially, intellectually, and operationally to interacting with AI that is no longer a “tool” or “assistant” but a “supervisor” in the full meaning of the word.

Initial non-scientific attempts to explore that question have already been undertaken. Due to their non-academic nature, such studies have limited scientific value, and it would be risky to presume that their findings reflect with a high degree of accuracy and generalizability either human beings' current attitudes toward or likely future responses to supervisory AI. Nevertheless, the fact that such large-scale studies have begun to be undertaken (and that their findings have been reported in popular business media) suggests growing interest in such questions, both in the world of business management and society more broadly. For example, an online survey of 1,080 managers in the United States conducted in 2019 by LEADx, a producer of AI-based leadership coaching apps, reported that 20% of workers would replace

their boss with a robot today, if that option were available; the number rose to 30%, if the workers could be guaranteed that their new robot boss would be an android that behaved in a friendly, human-like manner. Younger workers and male workers were the most likely to welcome a robot boss (Kruse 2019). Meanwhile, in an online survey published by Future Workplace and the Oracle software company in 2019 (Oracle 2019a, 2019b) that gathered input from 8,370 managers and employees in 10 countries, 50% of the overall participants reported that they were “currently using some form of AI at work,” ranging from a high of 78% of workers surveyed in India to a low of only 29% of surveyed workers in Japan. Of all workers surveyed, 82% thought that “robots can do certain types of work better than their boss can,” 64% “would trust a robot more than their manager,” and 50% “have asked a robot for advice instead of their boss.” Over 80% of respondents in India, China, and Singapore reported that they trust robots more than their human managers, while fewer than 60% said the same in the US, France, and the UK. As potential supervisors, robots were valued especially for their ability to manage work schedules and budgets, solve problems, and offer unbiased information. In contrast, human managers were valued for their empathy and ability to coach employees and create a positive work atmosphere. The survey found significant growth in positive attitudes toward workplace AI over a similar poll conducted by the same organizations in 2018, suggesting the rapid evolution of workers’ attitudes in this area.

The Earliest Vision Of The “Robot” As A Supervisor

The fact that robots might come to oversee human workers should perhaps not strike us as something bizarre, when we recall the fact that, from its very inception, such possibilities were built into the concept of the “robot” by the author who invented the term. The idea that robots might someday serve as supervisors of human workers within an organizational context is, quite literally, as old as the word “robot” itself, as the work that introduced that word “robot” to the world – the 1921 play *R.U.R.: Rossum’s Universal Robots* by Czech playwright Karel Čapek – presents in its later scenes a group of robots who have taken over the world and formed their own government and industries, as they struggle to successfully manage one of the last surviving human beings in carrying out work that is essential for the robots’ long-term survival (Čapek 2004). As depicted by Čapek in his pioneering drama, robots were not the cold mechanical automata of many later science fiction works; rather, they were biologically engineered beings who shared the same emotions, intellect, and sociality as their makers. Indeed, they were initially created to replace human workers and provide a vast source of cheap labor. However, in the end, they proved to be far too “human-like”: they were not only capable of following instructions but also of giving them – of building organizations and managing entire robot workforces for their own ends. A century later, reality has not yet caught up with Čapek’s vision, but the picture that he painted no longer seems so far away. Artificially intelligent systems are increasingly providing at least limited oversight and management of human workers, and it is now possible to envision the path by which future robots and AI will come to serve as “supervisors” of human workers in a robust sense of the word.

Considerations In Analyzing The Capacities And Limitations Of “AI”

In analyzing the potential roles available for supervisory AI, it is important to distinguish a number of partially overlapping concepts. For example, the term “artificial intelligence” is used with divergent meanings across diverse scientific disciplines. Scholars writing in technical contexts may make clear distinctions between limited and domain-specific forms of “artificial narrow intelligence”, more flexible and sophisticated forms of human-like “artificial general intelligence”, and forms of “artificial super intelligence” that significantly surpass human beings’ typical cognitive abilities (Saghiri et al. 2022), while more passing references to “artificial intelligence” in the scholarly literature of disciplines outside of computer science may use the term in a more casual sense, without indicating which of the three abovementioned meanings (or which other alternative concept) is being referenced. Given the wide range of phenomena that can be grouped under the broad rubric of “artificial intelligence,” one must be cautious when making (or analyzing) claims that “artificially intelligent” systems for managing human workers either (1) already exist and are in widespread use; (2) exist as prototypes but are not yet widely deployed; (3) do not yet exist but are likely to be developed in the next few years; (4) may or may not ever be developed, depending on whether certain technological, organizational, legal, or economic challenges can be overcome; or (5) are certain never to be developed.

Researchers employing the term “AI” in the sense of “artificial narrow intelligence” may be justified in discussing the countless ways in which “AI” has for years been playing significant roles in managing human workers, either for good or ill (see, e.g., De Stefano 2020a, De Stefano 2020b, Dong et al. 2022), while researchers who employ the term “AI” to refer to something more akin to “artificial general intelligence” may be equally justified in considering how many years it will be before “AI” is introduced into workplaces to begin managing human workers and in investigating the implications that may arise when that occurs (see, e.g., Chamorro-Premuzic and Ahmetoglu 2016, Mélypataki 2019, Mays et al. 2021).

References throughout this text to the capabilities and limitations of potential artificially intelligent supervisors of human workers may generally be taken to relate to forms of AI that are more advanced than currently widespread forms of “artificial narrow intelligence” but which do not require full “artificial general intelligence” – i.e., forms of AI that are capable of performing a significant range of the managerial functions currently performed by human managers, but without needing to be indistinguishable from human managers or to be their equals in every regard.

The AI Boss As An “Entity” Rather Than An “Approach” Or “Process”

This text seeks to analyze potential organizational roles of the “AI boss” understood as a particular sort of entity which – while not an “entity” in the same sense as a human being – is nevertheless more than simply a “process” or a particular technologically savvy “approach” to organizational management. The fact that an AI boss will be popularly perceived by human workers as an entity (see, e.g., Chamorro-Premuzic and Ahmetoglu 2016, Captain 2017, Kruse 2019, Mélypataki 2019, Mays et al. 2021) is not simply an effect of human cognitive biases but a reflection of the AI boss’s nature, which differentiates it from workplace processes like

digitization, digitalization, and algorithmization which – while emerging during roughly the same time period – are conceptually distinct from AI.

In many academic contexts, the terms “digitization” and “digitalization” are used interchangeably (Brennen and Kreiss 2016). Other scholars make explicit distinctions between the two concepts: in these cases, “digitization” may be understood as “the encoding of actions or representations of actions into a digital format (zeros and ones) that can be read, processed, transmitted, and stored by computational technologies” (Leonardi and Treem 2020) or as the concrete computational and “material process of converting analog streams of information into digital bits” (Brennen and Kreiss 2016). A related concept is that of “datafication,” which is “the practice of taking an activity, behavior, or process and turning it into meaningful data” (Leonardi and Treem 2020). “Digitalization,” meanwhile, can be understood as a higher-order societal process in which “many domains of social life are restructured around digital communication and media infrastructures” (Brennen and Kreiss 2016); as “the ways in which social life is organized through and around digital technologies” (Leonardi and Treem 2020); or as “the integration of multiple technologies into all aspects of daily life that can be digitized,” which is manifested in phenomena like “smart homes” and “smart cities” (Gray and Rumpe 2015). The fluidity of the concepts is evidenced, for example, in the work of Kagermann (2015), who references the understanding of “digitization” as “the networking of people and things and the convergence of the real and virtual worlds that is enabled by information and communication technology (ICT)” – a phenomenon which, as indicated by the definitions cited above, other scholars would more readily classify as “digitalization”.

“Algorithmization,” meanwhile, is often understood as an intentional process by which certain types of decisions that were once made by human beings on the basis of their experience and judgment (insofar as they were made at all) are now made by automated systems using formulas or machine-learning models that have been designed to make such decisions; within the field of HR management, for example, such automated tools for “people analytics” may make decisions in “people-related organizational processes such as hiring, retention, or staffing” (Hüllmann 2022). Other scholarly uses, however, highlight the extent to which (for example) human prejudices or biases may undergo a process of “algorithmization” in which they become assimilated into automated systems to be manifested by machine-learning models or other forms of AI in a manner that was not explicitly intended by the systems’ designers (Carrera 2020). With reference to such organizational phenomena, one might say that the AI boss is a particular manifestation, agent, and embodiment of ongoing processes of digitization, digitalization, and algorithmization.

The Ways In Which AI Can Influence Or Control Human Subordinates

Existing theory suggests that there are indeed diverse ways in which an AI boss can potentially control human subordinates and cause them to behave in certain manners. Current forms of AI are better at exercising some forms of control than others; as AI grows in sophistication, the mechanisms of control available for use by AI will grow more diverse. In particular, the ability to engage effectively in social interactions and relations with human workers in order to advance organizational goals is expected to be an essential capacity for robot bosses of the future (Author 2014a).

Raven's (1992) seminal analysis of the bases of social power that allow one intelligent social agent to exercise power over another distinguishes "coercive," "reward," "legitimate," "referent," "expert," and "informational" power. Hou and Jung (2018) note that even an artificially intelligent system that is never officially designated as a "supervisor" (and which lacks "legitimate" power) may, in effect, end up wielding tremendous power over an organization's human workers and influencing their behavior if, for example, it possesses expert knowledge and controls information flow; has the ability to reward or punish workers' actions (e.g., by allocating desirable or undesirable work schedules, tasks, or office space); or possesses human-like charisma and (apparent) personality or values that make human employees want to "please" or to become more like the robot.

While the possibility of robot supervisors relying on their emotional and social intelligence, charisma, and charm to motivate or manipulate human subordinates might seem far-fetched, steady advances are being made in the creation of more emotionally and socially capable robots. For example, much thought has been put into developing facial expressions that robot supervisors could use to offer clear signs of approval or disapproval to neurodiverse human subordinates (see e.g. McKenna et al. 2017). Such advances increasingly open the door to robot supervisors exercising control over human subordinates through referent power and charismatic authority (Author 2014b; Hubner et al. 2019).

"Robot Boss" Or "AI Boss"?

Some authors write about the emerging "robot boss" (McKenna et al., 2017; Hou and Jung, 2018), while others speak of an "AI boss" (Hodson, 2014; Feldman, 2019), which raises the question of whether a substantive difference exists between the two terms. The phrase "robot boss" readily suggests an entity possessing a physical body that allows it to sense and manipulate its environment and to interact socially with human beings, while the term "AI boss" tends to suggest a software-based supervisor that interacts with human beings through apps that are not tied to a specific physical shell (e.g., device-independent cloud-based platforms). However, there is no clear dividing line between a "robot" and "AI": both kinds of entities require physical embodiment, and both rely on some form of software or machine learning to guide their behavior. The difference between the terms relates more to emphasis and appearance than to any underlying reality (see, e.g., the largely interchangeable use of the terms in Ashrafian 2015).

As Rajan and Saffiotti (2017) have noted, the founders of the field of artificial intelligence dealt holistically with the challenge of constructing artificial entities that were capable of "perception, reasoning, and actuation," which required them to draw equally on the fields of electrical and mechanical engineering (for developing a synthetic agent's sensory and motor capacities) and computer science and programming (for developing a synthetic agent's data-processing and decision-making capacities). Over the following decades, the hardware-focused robotics and software-focused AI diverged somewhat; however, they are increasingly becoming theoretically and practically reunified, as the realization grows that every artificial intelligence always manifests itself, in some sense, as a physically embodied robot. Throughout this text, the terms "robot boss" and "AI boss" will thus be used more or less interchangeably.

The AI Boss As A Manifestation Of The “Technological Posthumanization” Of Organizations

The advent of the robot boss is yet another aspect of the ongoing “technological posthumanization” of organizations that has been gathering speed in recent years. Such posthumanization can be understood as the process by which an organization comes to include diverse types of intelligent social actors – beyond just natural biological human beings – who are capable of perceiving, interpreting, and influencing their shared environment and who work together to achieve the organization’s goals.

In earlier eras of human civilization, enterprises like farms and military organizations were often “non-technologically posthumanized” through the incorporation of non-human intelligent social actors in the form of animals that collaborated with human workers in order to accomplish certain tasks. In today’s organizations, posthumanization is primarily technological in nature. It manifests itself through two complementary forms: (1) the rise of artificially intelligent social actors in the form of workplace robots and AI that introduce non-human agency into an organization and (2) the rise of ubiquitous computing, augmented and virtual reality, online social media, mobile and wearable devices, neuroprostheses, and other technologies that are increasingly modifying and regulating the ways in which human beings exercise agency within organizations (Author 2017; Author 2018a; Author 2018b).

THE HISTORICAL RELATIONSHIP OF AI TECHNOLOGIES TO HUMAN WORKERS

The last seventy years have been characterized by organizations’ development and deployment of ever more sophisticated computing technologies, with the result being that many contemporary workplaces already incorporate AI that is capable of exercising partial supervision over limited aspects of human beings’ work.

The Computer As A Workplace Tool: Electronic Automation Of The 1950s

Machines capable of semi-automated data-processing and analysis began to be employed in earnest in organizational contexts by the 1950s, as exemplified by the early electronic computers like ENIAC, MANIAC, and UNIVAC, utilized by the US Government. In the beginning, the relationships between such computerized systems and the human beings that operated them were transparent: just like forklifts, timeclocks, elevators, welding equipment, and other devices used to perform particular tasks, such computers were no more than “tools” to be manipulated by their human operators – and even their long-term value as tools was subject to some doubt. For example, in 1959, a Vice President of General Electric (and later president of the Academy of Management) wrote with some skepticism about those seemingly overzealous individuals who were “entranced with the computer as a tool and a mechanism” for use in centralized data-processing within businesses (Smiddy, 1959, p. 25).

Given the limited utility of such automated systems as organizational tools during the early decades of the electronic age, the possibility that computers might someday be capable of filling a role as colleagues, collaborators, or supervisors of human workers was deemed

scarcely worthy of serious discussion by scholars – although, as illustrated by Čapek, such visions were already being explored by writers of speculative fiction.

The Rise Of The Robot As A Teammate

Over time, as computers gradually became more compact, portable, and sophisticated, they became integrated into physical systems that – unlike a slide-rule or digital calculator – did not simply perform calculations that were inputted into them by their human operators. Instead, computerized devices were engineered to sense, interpret, and physically manipulate their environment in rich and complex ways. By the end of the 20th century, such semiautonomous embodied *robots* had found diverse applications within organizations – from the robotic lunar probes and Mars landers and rovers that explored distant worlds as part of national space programs to the assembly-line robots that welded parts into place in manufacturing plants, to the self-navigating vehicles that transported materials throughout warehouses and factories. Nevertheless, such machines were from the beginning barred from exercising high-level managerial authority: their decisions had to be approved by one or more human overseers.

Two pivotal incidents significantly undermined faith in fully autonomous machines in certain circles. The first was the case of Vasili Arkhipov, a Soviet naval officer serving on a submarine during the Cuban Missile Crisis. Upon being subjected to an apparent attack by American ships while submerged, the submarine's three senior officers had to decide unanimously among themselves whether to launch a retaliatory nuclear attack, as they were cut off from communication with their headquarters in Moscow. According to procedures, the crew had the right to counterattack. Out of the three senior officers, only Arkhipov initially rejected the idea of a counterattack; by persuading the other two to agree with him, he prevented further escalation of the clash (Savranskaya, 2005). The second case was that of Petrov and the supposed “American nuclear missiles.” While on duty in 1983, Soviet Lt. Col. Stanislav Petrov was informed by a computerized early-warning system that the US had launched several nuclear missiles that were rapidly approaching the Soviet Union. According to procedures, Petrov should have taken steps to initiate a retaliatory nuclear attack. However, Lt. Col. Petrov felt some instinctive doubts, and he failed to take the required actions that, most probably, would have resulted in a nuclear war. His decision was later justified when the system's warning was determined to be a false alarm (Lundgren, 2013). If the Soviet computer system had acted autonomously without a human in the loop, the decision would likely have differed from that made by Petrov – with tragic consequences. Both cases are cited by those who oppose allowing autonomous decision-making by AI, claiming that algorithms lack empathy and moral awareness that may jeopardize individuals, organizations, or even whole countries.

Nevertheless, as computing technologies continued to grow in power and sophistication, new generations of robots and computerized systems began to function with ever greater autonomy from human personnel and to exercise their own agency in analyzing and responding to real-time situations. Such systems were gradually incorporated into various dimensions of organizational life, from cleaning facilities and protecting data and resources to value and product creation. The gradual increase of such machines' autonomy has been described as a process of “techno-empowerment” (Author and Skowroński 2021). By the early 2000s, some taxonomical accounts of human-robot interaction began to recognize the possibility that human workers might potentially fill a role as “teammates” who operate in collaboration with such

proactive and independent robots, rather than simply controlling the robots' behavior as their "supervisors" or "operators."¹ Robots were no longer simply confined to the status of a "tool" to be manipulated; they could, in certain circumstances, operate alongside human workers, collaborating on the same organizational plane. Nevertheless, within the field of management studies of the early 2000s, the notion that robotic systems might fill a role as supervisors of human subordinates was still largely deemed unworthy of serious investigation, either because of its supposed theoretical inconceivability or practical unlikelihood. Thus, for example, the taxonomical account of human-robot interaction developed by Yanko and Drury (2004) recognized the possibility that human beings could be "supervisors" or "operators" of robots – or potentially even "teammates" operating in collaboration with such robots – but not subordinates; the relationship of supervision between a human being and a robot could be ordered in only one direction.

From Robots As "Teammates" To Robots As "Supervisors."

It is not surprising that it has proven challenging to develop robots that can function effectively as managers when we are still struggling to develop a comprehensive and accurate theory regarding what it is that makes some human beings (but not others) great managers (see, e.g., Flak 2019). As a result, in recent years, scholars have still largely continued to focus their research on how artificial intelligence is leading to situations in which "employees collaborate with, rather than merely control, the technology in use" (Snow et al. 2017); exploration of how AI might supervise, manage, and control human workers is still in its earliest stages. Nevertheless, some recent systematic accounts have now begun to recognize that robots may indeed fill the role of true "supervisors" of human beings (Hou and Jung 2018).

¹ Robotic "teammates" have – thus far – clearly been of a qualitatively different sort than *human* "teammates." In this regard, such robots are similar, for example, to the specialized breeds of shepherd dogs that had functioned for centuries within the organizational context of large farms: such dogs were not simply "tools" in the way that a plow or hammer was a tool; they were teammates who often operated semi-independently of their human supervisor. Within contemporary organizations and societies, robotic teammates are filling a role similar to (though distinct from) that of the working animals of earlier eras.

THE THIRD WAVE OF BUSINESS TRANSFORMATION AND THE AI BOSS OF THE FUTURE

Numerous contemporary organizations are now attempting to take that next step by pursuing the development of specialized workplace AI whose managerial capacities rival (or surpass) those of the human supervisors whom it may someday replace; such organizations have an optimistic, ambitious vision for the role that AI supervisors can play within organizations and are working hard to bring about that reality. Indeed, in a study that applies Causal Layered Analysis to a discussion of organizational futurists and leaders, Farrow (2020) suggests that the notion of the “AI boss or chief advisor” is a notable element of the “Myth/Metaphor” layer of the organizational “teams of the future.” Such visions are fueled in part by the rise of the “quantifiable workplace” in which vast numbers of key decisions are objectively data-driven, rather than based on intuition, instinct, or emotional intelligence; as organizations become more data-driven, the door is being opened for robot supervisors to take on an increasing range of roles (Sahota and Ashley 2019).

Machines that make such autonomous decisions concerning resources allocation, acceptance of contracts, stock-exchange transactions, or the selection of particular employees have been described as “tertiary intelligent machines” and are perceived to represent the ultimate stage of techno-empowerment (Author and Skowroński 2021). Even if the construction of some such machines is already becoming technically possible, many people seem skeptical about whether they should be used.

AI As A Supervisor Of Human-Robot Collaboration Within Businesses

Following earlier waves of standardization and automation, Daugherty and Wilson (2018) see a dawning “third wave of business transformation” based around organizational adaptation in which human beings and AI systems collaborate; as part of this “emerging symbiosis between man and machine,” robots and AI will increasingly augment human beings’ capabilities and leave human persons to carry out the more complex work of “resolving ambiguous information, exercising judgment in difficult cases, and dealing with dissatisfied customers.” Simultaneously, organizations in many industries are increasingly becoming hybrid “digital-physical” and “cyber-physical” entities in which real-time decision-making is distributed throughout a heterogeneous network of human, robotic, and other agents (Author 2017; Author 2019b). Such visions of ever closer human-robotic interaction raise the question of who is best suited to manage such collaboration within an organization and ensure that tasks are allocated effectively: a human supervisor or robotic supervisor?

Some companies believe that artificially intelligent supervisors have greater potential for filling such roles, and they are working to implement that model. For example, Siemens is engaged in an ongoing effort to develop factories in which an AI supervisor assigns tasks to particular human workers or to robots, based on the AI’s analysis of the actions needed to complete a given task and its knowledge of individual workers’ skills and the robots’ capabilities. The goal is to create a system in which the AI supervisor can draw seamlessly on the unique strengths of human and robotic workers, without assigning either to carry out tasks that are a suboptimal use of their particular abilities (see, e.g., Feldman 2019, and that text’s analysis of Captain 2017).

AI In Other Managerial, Supervisory, Or Advisory Roles

Japanese firms like Hitachi and ORIX have been at the forefront of adapting AI for use in key advisory or decision-making roles. One vision for organizational structures of the future is that “While leaving day-to-day affairs to an artificially intelligent president-cum-chief operating officer, a human chairperson-cum-CEO would make final decisions. It may be only a matter of time before such a corporate governance model emerges” (Nikkei Asian Review 2016). Already, a Hong Kong-based venture capital firm has publicly heralded the fact that it appointed a machine learning program named VITAL to serve as a member of its board. However, it is unclear exactly what such a role might mean from a practical, legal, or organizational perspective (Groome 2014).

Just as human decision-makers choose which forms of artificial intelligence an organization will employ, AI is increasingly playing a role in choosing who *its* human collaborators within an organization will be, by serving as a “gatekeeper” that makes key decisions regarding the hiring of new employees. Experts and practitioners in the field of organizational incentives, rewards, and recognition (IRR) have noted that AI is currently used most extensively in the area of talent acquisition and onboarding (e.g., the algorithmic screening of job applications), with growing roles for AI in predictive analysis for supporting employee retention; facilitating learning by human workers; and motivating employees and managing their performance (Schweyer 2018). In some organizations, artificially intelligent systems also identify those human workers who should be terminated for poor performance (e.g. Lecher 2019).

FURTHER RESEARCH: CHALLENGES OF THE AI BOSS AS PART OF A POSTHUMANIZED HYBRID SYSTEM

The data presented so far demonstrate that the “AI boss” has been evolving from a strictly futurological idea to specific implementations in the form of various types of rational agents that are increasingly becoming incorporated into business organizations. In this way, a previously existing team of employees (in production, services, trade, etc.) is transformed into a hybrid system. Since such changes are not yet widespread, it is an important moment for analyzing and evaluating them scientifically. In practical terms, it remains possible to prevent harmful effects of this type of business experiment, such as in the form of counterproductive behaviors like the boycotting of management decisions or retaliatory behaviors (Robinson and Bennett 1995). On the other hand, an in-depth analysis will make it possible to identify factors that favor the optimization of business processes through delegation of managerial roles to artificial actors. Moreover, within the cognitive dimension, we are dealing with a fascinating area of research into technological posthumanization. The business organization – the environment of the digital transformation processes that interest us – naturally elicits a systemic view of issues of human-computer interaction, broadly understood. In this area, the most important thing is the effectiveness of changes, which is assessed, for example, at the level of economic indicators (e.g., company income or profit) or psycho-social indicators (e.g., job satisfaction or an assessment of positive techno-empowerment). These aspects can be treated as various dimensions of a company’s well-being, which – depending on the degree of success

in achieving stated goals – are interpreted as “success” or “failure”. Obtaining successful results through the introduction of AI bosses (as part of broader program of digitalization and algorithmization) means that “human-computer interaction” has been successfully transformed into “human-computer satisfaction”.

Recently, Margaret Kern and her colleagues proposed the concept of Systems Informed Positive Psychology (SIPP) (Kern et al. 2020) as a perspective for studying the well-being of social systems, including business organizations. Although the SIPP authors focus on interpersonal systems, this theory is an inspiring perspective for the analysis of hybrid systems which can facilitate the flourishing of organizations. Studying the determinants of shaping positive systems indicated by SIPP is possible thanks to concepts explaining the emergence of beneficial effects of human interaction with intelligent artifacts. Tomas Sander (2011) proposed “Positive Computing” as “the study and development of information and communication technology that is consciously designed to support people’s psychological flourishing in a way that honors individuals’ and communities’ different ideas about the good life” (p. 311). Giuseppe Riva et al. (2012) introduced “Positive Technology” which is “the scientific and applied approach to the use of technology for improving the quality of our personal experience — as a way of framing a suitable object of study in the field of cyberpsychology and human-computer interaction” (p. 70). Recently, Author (2021) suggested the term “Positive Cyberpsychology” to denote the area of research conducted at the interface between cyberpsychology and positive psychology, aimed at defining subjective (e.g., beliefs), objective (e.g., humanoid robots), and contextual (e.g., the employee team) determinants of the optimal functioning of human beings interacting with artificial entities. This approach encourages taking into account the dimension of the individual employee (human well-being), the organization in which he or she operates, and specific, implemented technological innovations.

The SIPP authors propose that research should be guided by the principles derived from systems theory (Bertalanffy 1968). As a starting point for future investigations of the emerging phenomenon of the AI boss, it is possible to outline a number of research areas, along with detailed questions about the posthuman transformation of organizations.

Challenge 1. Boundaries

What are the features of artificial agents that make them capable of being incorporated into an employee system in the role of an AI boss?

A rational agent can cross the boundary of the employee system to become incorporated into it, as long as this has the approval of an organization’s management. The content of expectations, in turn, depends on the real possibilities of designing AI-based systems. When analyzing the boundaries of the hybrid system, attention should thus be paid to the objective determinants of the organizational change – i.e., to its technological foundation. An appropriate basis for such research would be technology adoption models (Venkatesh et al. 2003); concepts such as Experience Design (Hassenzahl 2010), Positive Design (Desmet and Pohlmeier 2013), Motivation, Engagement and Thriving in User Experience (Peters et al. 2018); and research on algorithm aversion (Dietvorst et al. 2015; Castelo 2019). Thus far, no studies have been carried out that would reveal the social mechanism associated with acceptance of AI as a supervisor; it is therefore necessary to integrate data from studies carried out in the abovementioned

paradigms. Another promising path is reference to the relational models theory (Fiske 1992) that postulates that human relations may be based largely on combinations of four relational models: communal sharing, authority ranking, equality matching, and market pricing. Within this concept, the results of studies in which an artificial agent acted as a supervisor can be interpreted (Hinds et al., 2004). It should be anticipated that AI-based innovations will be increasingly capable of performing objective tasks (based on rationality and the application of the rules of logic). In comparison to them, “subjective tasks” require greater use of emotions and intuition (Inbar et al. 2010). This reality significantly limits the potential current scope of an AI boss’s managerial activity. However, as previously shown, work is underway to improve such synthetic agents’ interpersonal skills (e.g., in the field of emotional expression). Nevertheless, it should be expected that an AI boss will be primarily in demand where precise instruction, control, scheduling, and analysis of indicators (including KPIs) are necessary. Because businesses generally only accept solutions that lead to the desired effects, the real value of an artificial agent will have to be scrutinized by eliminating any anthropomorphizing filter – and thus without projecting skills that do not exist.

Challenge 2. Adaptation

How should artificial units be introduced into the employee system to maximize its well-being?

Introducing an AI boss is a process that – if it is to be successful – should begin by neutralizing negative, irrational attitudes of employees that block progress. The process of disseminating particular types of innovations (which should in principle improve quality of life) can be traced by mapping the years of introduction of the methods of measuring the fears that they arouse: the *Computer Anxiety Scale* (Heinssen et al. 1987), *Internet Anxiety Scale* (Chou 2003), *Robot Anxiety Scale* (Nomura et al. 2006), *Mobile Computer Anxiety Scale* (Wang 2007) and *Artificial Intelligence Anxiety Scale* (Wang and Wang 2019). It can be predicted that if AI bosses are carelessly implemented, there will also be a need to measure the level of fear toward such entities; an appropriate scale should thus be constructed. However, this can be avoided if a process of adaptation to this new type of agency and control is adequately carried out. Three stages can be distinguished: (1) preparation, including necessary antecedents and cognitive, affective, and behavioral readiness (Rafferty, Jimmieson & Armenakis, 2013); (2) action, including explicit reactions and change outcomes (Venkatesh, Morris and Davis 2003); and (3) cognitive, affective, and behavioral acceptance correlated with organizational prosperity, technological functionality, and individual well-being (including job satisfaction). From an individual viewpoint, an employee’s well-being is considered from a hedonistic or eudaimonic perspective. In the former case, it is about achieving job satisfaction and the associated emotions from the realm of pride and joy (e.g., Weiss and Brief 2004). The latter is about perceiving the meaning of work and the value of one’s personal involvement in it (e.g., Yeoman 2014). Social context refers to the quality of communication that shapes community and understanding of the process of change. People's uncertainty decreases as they gain information about some other party (Berger & Calabrese, 1975), and there is also a strong relationship between information sharing and the quality of team performance, consistency, knowledge integration, and decision satisfaction (Mesmer-Magnus & DeChurch, 2009). Research conducted over many years clearly shows that the manager and the management style that he or she manifests are essential for employees to achieve both dimensions of well-being.

For example, Jennifer Chiok Foong Loke's (2001) research shows that leadership behavior explains 29% of job satisfaction.

Interestingly, employee satisfaction can be generated thanks to leaders representing diverse management styles, including the transactional (Chen 2005), transformational (Shieh, Mills and Waltz 2001), charismatic (Holloway 2012), and authentic (Darvish and Razaei 2011). We also know that supervisors play an essential role in shaping a sense of meaningfulness at work (Pratt and Asghforth 2003). In this case, shaping the community of values and the possibility of meeting the expectations of both sides is of particular importance. The extent to which an AI boss can contribute to the emergence of similar effects is unknown. However, the effects of artificial agents on well-being are already undergoing scientific analysis (Botella et al. 2012). Following different trends in understanding well-being, we can distinguish "hedonic technologies" (which promote an increase in an actor's pleasure and satisfaction) and "eudaimonic technologies" (supporting the process of his or her self-realization) (Riva et al. 2012). There is a need to investigate the factors that might make a rational agent acting as an AI boss be treated in such ways.

Challenge 3. Self-organization

What factors favor the spontaneous organization of hybrid systems in which an AI boss is included?

Hybrid systems can be formed intentionally or spontaneously. In business, we often deal with the planned incorporation of artificial units into systems. However, human creativity for shaping interactions with artifacts is enormous. In the mental dimension, an example is the anthropomorphization that assigns to (potentially non-human) agents roles such as those of servant, master, or partner (e.g., Aggarwal and McGill 2007). Here we would also like to draw attention to the dimension of education. An AI boss can play the role of an "attractive artifact" in a community of workers, as in the famous series of "hole-in-the-wall" experiments carried out by Sugata Mitra (2012). There the social system centered around the artifact began to live "its own life". One also finds numerous examples of this on the Internet, where groups of support, interests, and knowledge-sharing are formed spontaneously. The attribute of "attractiveness" is essential, because, from the point of view of the organization's good, the most desirable situation is when employees accept an artificial unit and do not need to be additionally motivated to cooperate with it. Of course, the scope of possible interactions with technological innovation is limited by its structure and functionality. However, under the influence of various types of employees' interactions, intelligent agents may generate reactions of a new quality. An artificial individual that modifies its reactions thus shapes a stimulating environment in which employees acquire competencies unwittingly and informally (e.g., Marsick and Watkins 2001). It is most often a bottom-up process; it is situational and "immersed" in experience. The AI boss – which is itself subject to evolution – should help release creative potential in employees, which is particularly desirable due to the need to avoid employees getting trapped in suboptimal routines. Thanks to technological posthumanization, the labor system can become a learning system.

Challenge 4. Perspectives

What beliefs of employees are critical to effective functioning within a hybrid system where the artificial rational agent has superior status to them?

The introduction of an artificial unit to the work system in the form of an AI boss undoubtedly gives rise to a wide range of beliefs among employees. Particularly noteworthy is the possibility of granting moral status to such an agent in employees' mental processes (Gray, Gray and Wegner 2007). Research on mental perception shows that people use the so-called two-dimensional *cognitive moral template* when determining the moral status of perceived figures; this model presumes that persons reflect on the extent to which an entity can feel harm (i.e., the entity is a *moral patient*) and whether such an entity can take intentional action (i.e., the entity is a *moral agent*). It has been experimentally proven that various factors can influence how people ascribe such attributes to artificial beings. Here, an important role in the human-likeness of rational agents is played by the physical aspect (e.g., features of the corpus and the way of moving; see Gray and Wegner 2012; Saltik et al. 2021), as well as by the cognitive and emotional attributes (such as creativity; see, e.g., Castelo 2019). A fascinating area of research is the area of anthropomorphizing intentions. Messages in the general form of "AI wants to take jobs" found in pop-culture narratives depict a face of AI that corresponds to *The Dark Triad* of personality, which comprises the socially aversive traits of narcissism, Machiavellianism, and psychopathy (Paulhus and Williams 2002). Assigning these characteristics provokes an automatic assessment of the management style of an artificial system that is closer to the authoritarian style than the genuine or shared leadership preferred by employees (Yukl 2006). Recently, the concept of *The Light Triad* has been developed, including Kantianism (treating people as ends unto themselves), humanism (valuing the dignity and worth of each individual), and faith in humanity (believing in the fundamental goodness of humans) (Kaufman et al. 2019). The factors that can influence the anthropomorphization of rational agents in line with *The Light Triad* and the connections between assigning such attributes with relationships based on official dependence have not yet been determined and scientifically verified.

Challenge 5. Interconnectedness

What is the nature of the relationship between units most favorable for achieve well-being within the system?

The anthropomorphization process supports transforming an interaction into a relationship (Epley, Waytz and Cacioppo 2007). Business organizations promote community and teamwork by strengthening team spirit and shaping relations between employees on a formal and informal level. In the conditions of the COVID-19 pandemic in which working in home office conditions became prevalent, operating within virtual teams has become the norm for many employees. It is presumed that if the activities carried out within such a team are technologically supported, it becomes virtual (Anderson et al. 2007). An indicator of the team's level of virtuality is the degree of use of new technologies: from *semi-virtual* to *pure virtual* (Griffith and Meader 2004). Work during the COVID-19 pandemic has not only transformed employee teams into virtual teams; direct relations between employees have also taken the form of *para-social relations*. Such relationships were initially studied with regard to the psychological

determinants of television viewing and the bond generated between the viewer and the image of a person shown by the medium (Horton and Wohl 1956). These new conditions for achieving business goals provide an opportunity to define the similarities and differences between the quality of relationships between employees and their human supervisor (who is, in this case, an image on a computer screen) and between employees and an AI boss (e.g., represented as virtual character). Research on virtual teams indicates the essential role of the boss, which influences an employee's understanding of the meaning of the work performed (Furst 1999) and the coordination of tasks and sense of community (Hertel et al. 2005).

On the other hand, it is necessary to deepen the knowledge of the differences between direct contact with an artificial system (e.g., a robot) and its virtual image. A comparative analysis of twenty-seven studies shows that, in general, participants have a more positive attitude towards rational agents (robots) when watching them in films than when meeting them directly (Naneva et al. 2020). Additionally, it can be concluded that research should distinguish between a positive attitude towards an artificial system, trust in it, and acceptance of it. These variables should be treated as moderators of employees' reactions to an AI boss.

Challenge 6. Dynamics

How do the units of the system in which an AI boss is included interact with each other?

Business is a dynamic reality. With technological progress, new ways of satisfying customer needs emerge, along with the need to modify production, service, logistics processes, etc. Just as employees should be flexible and ready to acquire new competencies, artificial systems cannot be an obstacle to the company's development. The mutual influence of an AI boss and people who play the role of leaders – carrying out managerial tasks that the artificial entity cannot perform – is crucial in this aspect. This requires them to adopt a new style of work in which, for example, they can consult decisions with a synthetic rational agent. In such a situation, the manager resembles a chess player who cooperates with the chess program while playing a match, e.g., at the tournament in Leon. The final decision lies on the manager's side, but the decision-making process itself can be a stressful task for him or her, especially when an agent suggests a different choice. In addition, by analyzing the cooperation of a traditional manager with an AI boss, it will be possible to indicate the area of non-algorithmizable managerial competencies, which are vital from the point of view of the functioning of the team and the expectations of subordinates. Along with the adoption of AI bosses (as part of a broader organizational digitalization and algorithmization process), the notion of the “human capital” of the company changes. It should be expected that it will only include attributes that artificial units are unable to imitate (or can imitate only at a suboptimal level) in the future. This, in turn, will impact the training policy of companies, in which the emphasis will be placed on improving those skills defined as “soft” (i.e., necessary for performing subjective tasks).

DISCUSSION AND LIMITATIONS

The challenges outlined in the previous sections (which overlap in many areas) constitute important research lacunae that should be filled with subsequent research. First, it becomes imperative to identify the boundaries of adaptation to an AI boss for different types of

organizations. New technology is linked to stress (Jurek et al., 2021) so the knowledge on how people interact with supervisory AI is crucial to mitigate the risk of refusal. Currently, no studies indicate in which organizations the resistance to the AI boss is strongest and what factors stand behind such resistance. Moreover, it should be investigated whether there is a set of universal features of an AI boss that stand behind its acceptance, regardless of (1) the employees' culture and (2) the organization's culture. If such basic characteristics do exist, their determination becomes essential for practice. Nevertheless, differences in the perceptions of AI bosses in different cultures and organizations also seem worth exploring. For example, do perceptions about the ideal AI boss differ between bank and hospital employees? Moreover, it becomes crucial to define ways of controlling hybrid systems in which some form of AI boss exists. This is especially important in the era when robotic process automation is increasing its influence on companies' performance (Kedziora et al. 2021; Kedziora and Penttinen 2020; Kedziora and Kiviranta 2018). As we pointed out earlier, it is not clear how to avoid biases in a hybrid system or whether people display a sufficient level of non-conformism to oppose such biases. Earlier research shows that people have already problems to adapt to telecommuting where no artificial agents occur (Raišienė et al., 2021). It is not clear yet what kinds of crises may be dominant in a hybrid system. It is thus not known what tools could be used to deal with such crises effectively. Therefore, there is a need for experimental research in the above areas. Another identified research gap for which we found no answer in current theory is that of "deliberate system biasing." Namely, suppose that an AI boss operates on the basis on data collected from the environment that are selected by employees. Might they deliberately manipulate the system to bend and disrupt the organizational reality for their individual ends? Ultimately, it is still unclear who would take responsibility for the decisions made by the AI boss and who would be entitled to question them within the organization. The responsibility of artificial intelligence is one of the most significant emerging issues within contemporary ethics. Within business ethics, various concepts suggest that the responsibility for the decisions of an AI boss rests with its creators, with employees, or with senior managers. As with the other issues discussed above, the question of which of these options for assigning responsibility makes a team most likely to successfully adapt is unclear and requires further investigation (see, e.g., Santoni de Sio and Mecacci 2021).

Although this study is based on presumably reliable literature selected by the research protocol, the topic of techno-empowerment is dynamically evolving; it is probable that since this text has been submitted, new research, case studies, and IT-solutions have already appeared. Moreover, the further research directions are based on literature published in leading databases; we have purposefully omitted journals that are not reported in such databases. Ultimately, we have not included in this analysis more details about the functional capabilities of current IT systems in case of techno-empowerment, for two reasons. First, such capabilities are changing dynamically, and what seemed impossible yesterday may begin to appear in media reports only weeks later. Second, many of the most pioneering, cutting-edge technological advances regarding the functional capabilities of AI technologies (e.g., those occurring in projects developed by DARPA or the Chinese government) are not publicly reported, and it was not our aim to speculate on such unknowns.

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Authors' Note

All correspondence should be addressed to
Matthew E. Gladden
Georgetown University
USA

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