Part Two

Organizational Posthumanism

Abstract. Building on existing forms of critical, cultural, biopolitical, and sociopolitical posthumanism, in this text a new framework is developed for understanding and guiding the forces of technologization and posthumanization that are reshaping contemporary organizations. This 'organizational posthumanism' is an approach to analyzing, creating, and managing organizations that employs a post-dualistic and post-anthropocentric perspective and which recognizes that emerging technologies will increasingly transform the kinds of members, structures, systems, processes, physical and virtual spaces, and external ecosystems that are available for organizations to utilize. It is argued that this posthumanizing technologization of organizations will especially be driven by developments in three areas: 1) technologies for human augmentation and enhancement, including many forms of neuroprosthetics and genetic engineering; 2) technologies for synthetic agency, including robotics, artificial intelligence, and artificial life; and 3) technologies for digital-physical ecosystems and networks that create the environments within which and infrastructure through which human and artificial agents will interact.

Drawing on a typology of contemporary posthumanism, organizational posthumanism is shown to be a hybrid form of posthumanism that combines both analytic, synthetic, theoretical, and practical elements. Like analytic forms of posthumanism, organizational posthumanism recognizes the extent to which posthumanization has already transformed businesses and other organizations; it thus occupies itself with understanding organizations as they exist today and developing strategies and best practices for responding to the forces of posthumanization. On the other hand, like synthetic forms of posthumanism, organizational posthumanism anticipates the fact that intensifying and accelerating processes of posthumanization will create future realities quite different from those seen today; it thus attempts to develop conceptual schemas to account for such potential developments, both as a means of expanding our theoretical knowledge of organizations and of enhancing the ability of contemporary organizational stakeholders to conduct strategic planning for a radically posthumanized long-term future.

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I. Introduction

'Posthumanism' can be defined briefly as an intellectual framework for understanding reality that is post-anthropocentric and post-dualistic; for posthumanism, the 'natural' biological human being as traditionally understood becomes just one of many intelligent subjects acting within a complex ecosystem.[1] Some forms of posthumanism focus on the ways in which our notion of typical human beings as the only members of society has been continuously challenged over the centuries through the generation of cultural products like myths and works of literature that feature quasi-human beings such as monsters, ghosts, angels, anthropomorphic animals, cyborgs, and space aliens (i.e., through processes of nontechnological 'posthumanization').[2] Other forms of posthumanism address the ways in which the circle of persons and intelligent agents dwelling within our world is being transformed and expanded through the engineering of new kinds of entities such as human beings possessing neuroprosthetic implants, genetically modified human beings, social robots, sentient networks, and other advanced forms of artificial intelligence (i.e., through processes of technological posthumanization).[3] The development of sound and discerning forms of posthumanist

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[1] This definition builds on the definitions formulated by scholars of posthumanism such as Ferrando, Miller, Herbrechter, Miah, and Birnbacher, as well as on our own typology of posthumanism found in Part One of this volume, "A Typology of Posthumanism: A Framework for Differentiating Analytic, Synthetic, Theoretical, and Practical Posthumanisms." See Ferrando, "Posthumanism, Transhumanism, Antihumanism, Metahumanism, and New Materialisms: Differences and Relations" (2013), p. 29; Miller, "Conclusion: Beyond the Human: Ontogenesis, Technology, and the Posthuman in Kubrick and Clarke's 2001" (2012), p. 164; Herbrechter, *Posthumanism: A Critical Analysis* (2013), pp. 2-3; Miah, "A Critical History of Posthumanism" (2008), p. 83; and Birnbacher, "Posthumanity, Transhumanism and Human Nature" (2008), p. 104.

[2] Such forms of posthumanism include the critical and cultural posthumanism pioneered by Haraway, Halberstam and Livingstone, Hayles, Badmington, and others. See, e.g., Haraway, "A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s" (1985); Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (1991); *Posthuman Bodies*, edited by Halberstam & Livingstone (1995); Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (1999); Graham, *Representations of the Post/Human: Monsters, Aliens and Others in Popular Culture* (2002); Badmington, "Cultural Studies and the Posthumanities" (2006); and Herbrechter (2013).

[3] Such forms of posthumanism include philosophical posthumanism, bioconservatism, and transhumanism, which are analyzed in Miah (2008), pp. 73-74, 79-82, and Ferrando (2013), p. 29. Such approaches can be seen, for example, in Fukuyama, *Our Posthuman Future: Consequences of the Biotechnology Revolution* (2002); Bostrom, "Why I Want to Be a Posthuman When I Grow Up" (2008); and other texts in *Medical Enhancement and Posthumanity*, edited by Gordijn & Chadwick (2008).

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thought is becoming increasingly important as society grapples with the ontological, ethical, legal, and cultural implications of emerging technologies that are generating new forms of posthumanized existence.

The establishing of conceptual links between organizational management and the idea of the 'posthuman' is nothing new. As early as 1978, management scholars Bourgeois, McAllister, and Mitchell had written that "Much of the organization theory literature from the posthuman relations era concentrates on defining which organizational structures, management styles, et cetera are most appropriate (effective) for different technologies and/or environmental contingencies."[4] Writing in 1996, Gephart drew on fictional depictions of cyborgs to envision an emerging 'Postmanagement Era' in which an organization's complex network of computerized systems – with its own synthetic values and logic – would become the true manager of an organization that no longer exists and acts for the sake of human beings. Although a human being might still appear to function as a 'manager' within such an organization, in reality she would be neither a manager nor a natural, biological human being; instead she would possess the form of a cyborg who has been permanently integrated into her employer's operational, financial, and technological systems and who has been weaponized for commercial ends – a being whose human agency has been dissolved until she becomes little more than a cold and lethally efficient "posthuman subject, ripping at flesh as part of her job."[5]

More recently, scholars have explored potential relationships between posthumanism and particular specialized fields within organizational theory and management. For example, Mara and Hawk consider the relationship of posthumanism to the technical communication that constitutes an important

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[4] Bourgeois et al., "The Effects of Different Organizational Environments upon Decisions about Organizational Structure" (1978), pp. 508-14. This allusion to the posthuman is not elaborated upon elsewhere in the text. The article describes an empirical study that was conducted to test hypotheses relating to the default behavior of managers when their organizations encounter "turbulent and threatening business environments" (p. 508).

[5] See Gephart, "Management, Social Issues, and the Postmodern Era" (1996), pp. 36-37, 41. Strictly speaking, Gephart's approach is more postmodernist than posthumanist. While there are areas of overlap between postmodernism and posthumanism, postmodernism generally posits a more nihilistic deconstruction of the notion of 'humanity,' while posthumanism seeks to transform and expand the historically anthropocentric concepts of personal agency and subjectivity to incorporate quasi-human, parahuman, and nonhuman entities. See Part One of this volume, "A Typology of Posthumanism: A Framework for Differentiating Analytic, Synthetic, Theoretical, and Practical Posthumanisms," and Herbrechter (2013).

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form of information flow within contemporary organizations that are so dependent on technology. They note the evolving roles that organizations' human and nonhuman actors play in change management, organizational culture, human-computer interaction (HCI), and the integration of technology into the workplace within the context of a complex posthuman organizational ecology in which "it is no longer tenable to divide the world into human choice and technological or environmental determinism."[6] Barile, meanwhile, explores the impact that technologies for augmented reality play in creating 'posthuman consumers' by breaking down boundaries between the virtual and the actual and supplanting previous forms of HCI with "a new kind of interaction where the machines become softer and immaterial, emotions become contents, and places become media."[7]

Other scholars have sought to identify the ultimate drivers of the processes of posthumanization that are expected to increasingly impact organizations of all types. For example, Herbrechter notes the ongoing and intensifying 'technologization' of humanity, by which technoscientific forces that had previously constituted just one element of society attempt to gain economic and political power over all aspects of human culture.[8] Insofar as all organizations exist within human cultures, utilize technology, and are subject to economic and political forces, they become a participant in these dynamics of technologization and posthumanization. However, while the forces of technologization are undoubtedly real, they may not fully explain the rising prominence of posthuman dynamics and motifs within organizational life. Indeed, it has even been suggested that the popular notion of posthumanism may have been engineered as a sort of ruse generated by the power structures of postmodern neoliberal capitalism to pacify the masses with the hope or fear (or both) of a radically different future that looms just over the horizon.[9] According to that view, posthumanist imagery, themes, and philosophies are a mechanism employed by some organizations in order to facilitate the achievement of their strategic objectives.

While a diverse array of connections between posthumanism and organizational management has thus been hinted at for some time, it has not been

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[6] Mara & Hawk, "Posthuman rhetorics and technical communication" (2009), pp. 1-3.

[7] Barile, "From the Posthuman Consumer to the *Ontobranding* Dimension: Geolocalization, Augmented Reality and Emotional Ontology as a Radical Redefinition of What Is Real" (2013), p. 101.

[8] See Herbrechter (2013), p. 19.

[9] See the discussion of such cynical interpretations of posthumanism in Herbrechter (2013), p. 80.

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comprehensively or systematically explored. Much scholarship has been dedicated to understanding fields such as literature,[10] film,[11] computer games,[12] biomedical engineering,[13] and politics and economics[14] in light of posthumanist thought. However, efforts to apply posthumanist methodologies and insights to organizational management have remained relatively underdeveloped. This is striking, given the fact that many of the issues of interest to posthumanism have strong organizational repercussions.

In this text, we attempt to address this lacuna by presenting one approach to developing a comprehensive 'organizational posthumanism.' After formulating a definition for organizational posthumanism, we compare it to established forms of post-dualistic and post-anthropocentric posthumanist thought, arguing that it constitutes a type of 'hybrid posthumanism' that incorporates both analytic, synthetic, theoretical, and practical aspects. We then consider six organizational elements that will increasingly be impacted by the forces of posthumanization: namely, an organization's members, personnel structures, information systems, processes, physical and virtual spaces, and external environment. Finally, three main types of technologies that facilitate the development of organizational posthumanity are described; these are technologies for human augmentation and enhancement (including implantable computers, neuroprosthetic devices, virtual reality systems, genetic engineering, new forms of medicine, and life extension); technologies for synthetic agency (including social robotics, artificial intelligence, and artificial life); and technologies for building digital-physical ecosystems and networks (such as the Internet of Things). It is our hope that the questions raised and the framework formulated within this text can offer a useful starting point for those scholars and management practitioners who will address

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[10] See posthumanist analyses of literature in, e.g., Hayles (1999); *Posthumanist Shakespeares*, edited by Herbrechter & Callus (2012); and Thomsen, *The New Human in Literature: Posthuman Visions of Change in Body, Mind and Society after 1900* (2013).

[11] Examples can be found in the articles relating to cinema in *Posthuman Bodies* (1995); Short, *Cyborg Cinema and Contemporary Subjectivity* (2005); and Miller (2012).

[12] For such studies, see, e.g., Schmeink, "Dystopia, Alternate History and the Posthuman in Bioshock" (2009); Krzywinska & Brown, "Games, Gamers and Posthumanism" (2015); and Boulter, *Parables of the Posthuman: Digital Realities, Gaming, and the Player Experience* (2015).

[13] See, e.g., *Medical Enhancement and Posthumanity* (2008); Thacker, "Data made flesh: biotechnology and the discourse of the posthuman" (2003); and Lee, "Cochlear implantation, enhancements, transhumanism and posthumanism: some human questions" (2016).

[14] Examples of such analyses include Gray, *Cyborg Citizen: Politics in the Posthuman Age* (2002); Fukuyama (2002); and Cudworth & Hobden, "Complexity, ecologism, and posthuman politics" (2013).

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in an ever more explicit manner the increasingly important intersection of organizational life and posthumanist thought.

II. Definition of Organizational Posthumanism

Having considered the nature of posthumanism and some links that have been suggested between posthumanism and the theory and management of organizations, we are in a position to explicitly formulate a systematic approach that applies posthumanist insights and methodologies to the study and management of organizations. This approach can be described as *organizational posthumanism*.

Lune defines an organization as "a group with some kind of name, purpose, and a defined membership" that possesses "a clear boundary between its inside and its outside" and which can take the form of either a formal organization with clearly defined roles and rules, an informal organization with no explicitly defined structures and processes, or a semi-formal organization that possesses nominal roles and guidelines that in practice are not always observed.[15] Meanwhile, Daft et al. define organizations as "(1) social entities that (2) are goal-directed, (3) are designed as deliberately structured and coordinated activity systems, and (4) are linked to the external environment."[16] Such organizations include businesses, nonprofit organizations, schools, religious groups, professional associations, political parties, governments, and military organizations. Other collections of human beings – such as cities, families, or the proponents of a particular philosophical perspective – share some of the characteristics of organizations but are not generally classified as such.

The very nature of organizations is changing as ongoing technological and social change reshapes the capacities and relationality of the human beings who belong to organizations and creates new kinds of entities (like social robots) that can engage in goal-directed social interaction with human beings and one another. Organizational posthumanism can aid us in making sense of – and, ideally, anticipating and controlling – such changes. By way of a formal definition, we would suggest that:

> Organizational posthumanism is an approach to analyzing, understanding, creating, and managing organizations that employs a post-anthropocentric and post-dualistic perspective; it recognizes that the emerging technologies

[15] Lune, *Understanding Organizations* (2010), p. 2.

[16] Daft et al., *Organization Theory and Design* (2010), p. 10.

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> which complement traditional biological human beings with new types of intelligent actors also transform the kinds of members, structures, dynamics, and roles that are available for organizations.

As we shall see, while organizational posthumanism shares elements in common with established disciplines such as philosophical posthumanism, critical posthumanism, and biopolitical posthumanism, it also possesses unique and contrasting elements that prevent it from being understood simply as a subfield of one of those disciplines. Rather, we would argue that as defined above, organizational posthumanism is better viewed as an independently conceptualized body of thought within posthumanism. When understood in the context of organizational and management theory, organizational posthumanism does not represent a new discipline, insofar as it still addresses historical topics of organizational structures, systems, and processes; however, it does constitute an entirely new perspective and set of methodologies – a new approach.

III. Classification of Organizational Posthumanism as a Type of Posthumanism

It is possible to categorize different forms of posthumanism into general types by employing a two-dimensional conceptual framework that classifies a form of posthumanism based on its understanding of posthumanity and the role or purpose for which the posthumanism was developed. With regard to its perspective on posthumanity, a form of posthumanism may be: 1) an *analytic posthumanism* that understands posthumanity as a sociotechnological reality that already exists in the contemporary world and which needs to be analyzed; or 2) a *synthetic posthumanism* that understands posthumanity as a collection of hypothetical future entities whose development can be either intentionally realized or prevented, depending on whether or not human society chooses to research and deploy certain transformative technologies. With regard to the purpose or role for which it was created, a form of posthumanism can be: 1) a *theoretical posthumanism* that seeks primarily to develop new knowledge and understanding; or 2) a *practical posthumanism* that seeks primarily to bring about some social, political, economic, or technological change in the world.[17] This framework yields five general types of posthumanism:

[17] For a more detailed discussion of the distinctions between analytic, synthetic, theoretical, and practical posthumanisms, see Part One of this book, "A Typology of Posthumanism."

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- **Analytic theoretical posthumanisms** seek to understand the posthumanized present and include fields like critical and cultural posthumanism. Such disciplines can collectively be understood as constituting a 'posthumanism of critique' that employs posthumanist methodologies to diagnose hidden anthropocentric biases and posthumanist aspirations contained within different fields of human activity.[18]
- **Synthetic theoretical posthumanisms** envision hypothetical forms of posthumanity and include such pursuits as philosophical posthumanism and many forms of science fiction. Such fields could be seen as representing a 'posthumanism of imagination' that creatively conceptualizes future (or otherwise inexistent) posthumanities so that their implications can be explored.[19]
- **Analytic practical posthumanisms** seek to reshape the posthumanized present and include some forms of metahumanism and neohumanism. Such movements can be understood as constituting a 'posthumanism of conversion' that is aimed at changing hearts and minds and influencing the way in which human beings view and treat the world around themselves.[20]
- **Synthetic practical posthumanisms** seek to steer the processes that can generate a future posthumanity; they include such movements as transhumanism and bioconservatism. Such programs can be viewed as representing a 'posthumanism of control' that seeks to develop new technologies that give individuals control over their own posthumanization or to implement legal or economic controls to block the development of such technologies.[21]
- **Hybrid posthumanisms** that span all four spheres of the analytic, synthetic, practical, and theoretical include such phenomena as sociopolitical posthumanism and the metahumanism of Del Val and Sorgner. Such

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[18] For an example, see the critical posthumanism described in Herbrechter (2013).

[19] Regarding, e.g., posthumanist aspects of science fiction, see Short (2005); Goicoechea, "The Posthuman Ethos in Cyberpunk Science Fiction" (2008); Miller (2012); and Herbrechter (2013), pp. 115-17.

[20] Regarding different forms of metahumanism, see Ferrando (2013), p. 32. For the form of neohumanism developed by Sarkar, see Sarkar, "Neohumanism Is the Ultimate Shelter (Discourse 11)" (1982). A classification of different forms of metahumanism and neohumanism is found in Part One of this volume, "A Typology of Posthumanism."

[21] For examples, see Fukuyama (2002); Bostrom, "A History of Transhumanist Thought" (2005); and Bostrom (2008).

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> ventures can be understood as examples of a 'posthumanism of production' that develops a robust and rigorous theoretical framework that is then utilized to successfully generate concrete products or services within the contemporary world.[22]

By applying this framework, organizational posthumanism can be classified as a form of hybrid posthumanism that integrates strong analytic, synthetic, theoretical, and practical elements. We can consider each of these elements of organizational posthumanism in more detail.

A. Theoretical Aspects

Organizational posthumanism is theoretical insofar as it involves efforts to understand the ways in which organizations' form and dynamics are being affected by (and are shaping) processes of posthumanization. Such work involves developing new conceptual frameworks that can explain and predict the unique ways in which organizations will become agents and objects of posthumanization and will exist as elements of a larger posthumanized ecosystem.

For example, scholars can explore the ways in which organizations' members, personnel structures, processes, information systems, physical and virtual spaces, and external environment will be altered by the integration of artificial general intelligences, sentient robotic swarms, sapient networks, neuroprosthetically augmented cyborgs, genetically engineered human beings, and other posthumanized entities into organizations whose membership was previously the exclusive domain of unmodified, 'natural' biological human beings. Such posthumanization may allow the creation of new organizational forms that were previously impossible while simultaneously rendering some traditional organizational forms ineffective or obsolete.

In its theoretical aspects, organizational posthumanism draws on and can inform fields such as organizational theory, systems theory, and cybernetics. It can work in parallel with sociopolitical posthumanism, which explores at a theoretical level the impact of posthumanization on legal, political, and economic systems and institutions. Similarly, organizational posthumanism can take up many existing lines of theoretical inquiry within fields such as philo-

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[22] For an instance of sociopolitical posthumanism as it relates to law, see Berman, "Posthuman Law: Information Policy and the Machinic World" (2002). For the form of metahumanism developed by Sorgner and Del Val, see Del Val & Sorgner, "A *Metahumanist* Manifesto" (2011), and Del Val et al., "Interview on the Metahumanist Manifesto with Jaime del Val and Stefan Lorenz Sorgner" (2011).

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sophical, critical, and biopolitical posthumanism and science fiction and advance them in a way that is informed by a deeper concern for and insight into their implications at the organizational level.

For example, Miah notes posthumanism's longstanding interest in the blurring physical and cognitive boundaries between human beings and the tools that we use to accomplish work. Drawing on Mazlish, Miah notes that tools have historically served to extend human beings' capacities and freedom while simultaneously subjugating human beings to the organizational systems required for the tools' production and effective use.[23] Whereas tools can serve as an 'artificial skin' that mediates our relationship with our environment and offers us protection, they have also facilitated the creation of large, impersonal organizations in which human beings are reduced to functional bodies that provide some economic value. The creation of new tools such as neuroprosthetic devices is serving to make human beings "more machine-like, physically and cognitively," while the creation of increasingly autonomous tools such as artificial intelligences threatens to replace human beings altogether as components of some organizational systems.[24] Organizational posthumanism can develop new theoretical frameworks that shed light on such relationships between agent and instrument, between human 'employee' and nonhuman 'tool,' within the evolving context of posthumanized organizations.

B. Practical Aspects

Organizational posthumanism is also practical, insofar as its goal is not simply to understand at an abstract level the ways in which posthuman realities are affecting organizations but also to aid managers in proactively designing, creating, and maintaining organizations that can survive and thrive within novel competitive environments such as those emerging as a result of the posthumanization of our world. Just as sociopolitical posthumanism works to produce new legal, political, and economic systems that are adapted to emerging posthuman realities, so organizational posthumanism works to produce successfully posthumanized organizations – and, through them, to produce the goods, services, and other resources that such organizations release into the wider ecosystem. In its more practical aspects, organizational

[23] See Miah (2008), p. 82, and its discussion of Mazlish, *The Fourth Discontinuity: The Co-Evolution of Humans and Machines* (1993).

[24] Miah (2008), p. 82.

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posthumanism draws on, shapes, and acts through disciplines like organizational design, organizational architecture, enterprise architecture, organization development, management cybernetics, and strategic management.

Research has already begun to explore the practical implications of technological posthumanization (though without necessarily naming the phenomenon as such) for areas such as strategic planning, business models, entrepreneurship, marketing, knowledge management, and customer relationship management (CRM);[25] change management, organizational culture, and organizational HCI;[26] potential roles for artificial intelligences in leading teams of human workers;[27] and the creation of neurocybernetically linked organizational systems.[28]

C. Analytic Aspects

The fact that processes of posthumanization are expected to accelerate and expand in the future does not diminish the posthumanizing impacts that have already been felt and which every day are creating new opportunities and challenges for organizations. Organizational posthumanism is analytic, insofar as it strives to understand the changes to organizations that have already occurred as a result of such previous and ongoing processes of posthumanization. On the basis of such knowledge, managers and other organizational stakeholders can develop strategies and best practices to optimize the functioning of real-world organizations today.

For example, researchers in the field of organizational posthumanism might, for example, attempt to anticipate the implications of employing artificial general intelligences (AGIs) to fill roles as senior executives within otherwise human organizations.[29] Such efforts to imagine the eventual impacts of radically posthumanized far-future technological systems complement or-

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[25] See the thoughtful overview of the impacts of posthumanizing technologies on such areas in Berner, *Management in 20XX: What Will Be Important in the Future – A Holistic View* (2004).

[26] See Mara & Hawk (2009).

[27] See Gladden, "Leveraging the Cross-Cultural Capacities of Artificial Agents as Leaders of Human Virtual Teams" (2014); Gladden, "The Social Robot as 'Charismatic Leader': A Phenomenology of Human Submission to Nonhuman Power" (2014); and Gladden, "Managerial Robotics: A Model of Sociality and Autonomy for Robots Managing Human Beings and Machines" (2014).

[28] See Gladden, "Neural Implants as Gateways to Digital-Physical Ecosystems and Posthuman Socioeconomic Interaction" (2016).

[29] See, e.g., Gladden, "The Social Robot as 'Charismatic Leader'" (2014).

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ganizational posthumanism's efforts to analyze the impact that is already being felt on organizations by more rudimentary technologies for artificial intelligence, such as those that control industrial robots for assembly-line manufacturing,[30] automated systems for resource scheduling and planning,[31] web-based chatbots for basic interactions with customers, [32] and robotic sales associates for dispensing goods and services to customers.[33]

D. Synthetic Aspects

In addition to analyzing the kinds of posthumanized organizations that already exist today, organizational posthumanism seeks to envision the kinds of even more radically posthumanized organizations that may be able to exist in the future thanks to accelerating forces of technologization and other anticipated sociotechnological change.

In a sense, all long-term organizational decision-making involves a sort of 'futurology,' as stakeholders make decisions on the basis of their empirically grounded projections, estimates, or intuitions about how an organization's external context is likely to evolve over time (e.g., as captured in a PESTLE analysis[34]) and how the impact of a decision is likely to reshape the organization's internal form and dynamics. Organizational posthumanism involves a specialized form of organizational futurology that attempts to conceptualize and predict the ways in which organizations in general (or one organization in particular) will be transformed by the dynamics of posthumanization or will be able to exploit those dynamics for their own strategic purposes.

Within organizational posthumanism, the analytic and theoretical effort to understand effective posthumanized organizations and the synthetic and practical effort to design and create them are thus joined as two sides of a single coin.

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[30] For an overview of such technologies, see, e.g., Perlberg, *Industrial Robotics* (2016).

[31] See, e.g., *Automated Scheduling and Planning: From Theory to Practice*, edited by Etaner-Uyar et al. (2013).

[32] Such technologies are described, e.g., in Perez-Marin & Pascual-Nieto, *Conversational Agents and Natural Language Interaction: Techniques and Effective Practices* (2011).

[33] See, e.g., the account from a consumer's perspective of interactions with such technologies in Nazario, "I went to Best Buy and encountered a robot named Chloe – and now I'm convinced she's the future of retail" (2015).

[34] See Cadle et al., *Business Analysis Techniques: 72 Essential Tools for Success* (2010), pp. 3-6, for a description of various versions of this analytic tool.

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IV. Organizational Posthumanization as Reflected in Organizational Elements

One aspect of posthumanization is the emergence of a world in which natural human beings are joined by other kinds of entities such as cyborgs, social robots, AGIs, sapient networks, and artificial life-forms in serving as employees, collaborators, and consumers. This posthuman reality will increasingly be reflected in various aspects of organizational life. Particular implications of such posthumanization can be identified in the kinds of *members*, *structures*, *systems*, *processes*, *spaces*, and *external ecosystems* that organizations will possess.[35] Below we consider each of these elements.

A. Posthumanized Members

Traditionally, the members of organizations have been 'natural' biological human beings who have not been engineered or extensively enhanced with the aid of biomedical technologies. The membership of future organizations will comprise a much more diverse array of entities. It is expected that increasingly the members of organizations will, for example, also include:[36]

- Human beings possessing implantable computers (such as devices resembling subcutaneous smartphones)
- Human beings equipped with sensory, cognitive, or motor neuroprosthetics, including human beings who possess full cyborg bodies
- Genetically engineered human beings
- Human beings who are long-term users of virtual reality systems and whose interaction with other persons and their environment takes place largely within virtual worlds
- Social robots
- Artificial general intelligences

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[35] Structures, processes, and systems constitute the three main elements within the 'congruence model' of organizational architecture as conceptualized by Nadler and Tushman. See Nadler & Tushman, *Competing by Design: The Power of Organizational Architecture* (1997), p. 47.

[36] For an overview of the roles that such beings may play in future organizations, see Berner (2004). Discussions of specific types of posthumanized organizational members are found, e.g., in Bradshaw et al., "From Tools to Teammates: Joint Activity in Human-Agent-Robot Teams" (2009); Samani et al., "Towards Robotics Leadership: An Analysis of Leadership Characteristics and the Roles Robots Will Inherit in Future Human Society" (2012); Wiltshire et al., "Cybernetic Teams: Towards the Implementation of Team Heuristics in HRI" (2013); Gladden, "The Social Robot as 'Charismatic Leader'" (2014); Gladden, "The Diffuse Intelligent Other: An Ontology of Nonlocalizable Robots as Moral and Legal Actors" (2016); and Gladden, "Neural Implants as Gateways" (2016).

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- Artificial life-forms
- Sapient networks
- Human and synthetic beings whose thoughts and volitions have been cybernetically linked to create 'hive minds'

Such members will be discussed in more detail later in this text, in our analysis of technological changes facilitating organizational posthumanization. From an organizational perspective, the capacities, vulnerabilities, needs, and forms of interaction demonstrated by such entities can differ radically from those of the natural human beings who have historically constituted an organization's membership. The use of posthuman entities (including artificial beings) to fill organizational roles as senior executives, product designers, or the providers of sensitive goods or services (such as health care or military activities) raises a range of complex ethical, legal, and information security questions.[37] Organizational posthumanism can investigate the theoretical constraints and possibilities for creating organizations that include such posthumanized members and can develop practical approaches for the management of organizations that incorporate them.

B. Posthumanized Structures

The types of internal and external structures that are available for use by organizations are expected be reshaped and expanded by emerging posthuman realities. When managing contemporary organizations, possible organizational forms identified by Horling and Lesser include hierarchies (which can be either simple, uniform, or multi-divisional), holarchies (or 'holonic organizations'), coalitions, teams, congregations, societies, federations (or 'federated systems'), matrix organizations, compound organizations, and

[37] For a discussion of questions that can arise when entrusting organizational roles and responsibilities to robots and AIs, see, e.g., Stahl, "Responsible Computers? A Case for Ascribing Quasi-Responsibility to Computers Independent of Personhood or Agency" (2006); Sparrow, "Killer Robots" (2007); Calverley, "Imagining a non-biological machine as a legal person" (2008); Grodzinsky et al., "Developing Artificial Agents Worthy of Trust: 'Would You Buy a Used Car from This Artificial Agent?'" (2011); Coeckelbergh, "Can We Trust Robots?" (2012); Datteri, "Predicting the Long-Term Effects of Human-Robot Interaction: A Reflection on Responsibility in Medical Robotics" (2013); Gladden, "The Social Robot as 'Charismatic Leader'" (2014); and Gladden, "The Diffuse Intelligent Other" (2016). Regarding questions that arise in the case of neurocybernetically enhanced human workers, see, e.g., McGee, "Bioelectronics and Implanted Devices" (2008); Koops & Leenes, "Cheating with Implants: Implications of the Hidden Information Advantage of Bionic Ears and Eyes" (2012); and Gladden, "Neural Implants as Gateways" (2016).

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sparsely connected graph structures (which may either possess statically defined elements or be an 'adhocracy').[38] Such structures have been developed over time to suit the particular characteristics of the members that constitute contemporary organizations – i.e., natural biological human beings. As organizations evolve to include members that possess radically different physical and cognitive capacities and novel ways of interacting with one another, the kinds of structures that are available to organize the work of these groups of members will change, and novel organizational structures are expected to become feasible and even necessary.[39]

For example, an organization composed of neuroprosthetically augmented human members may be able to link them through a decentralized network that enables the direct sharing of thoughts and sentiments between members' minds, allowing information to be disseminated in an instantaneous fashion and decisions to be made in a distributed and collective manner that is impossible for conventional human organizations.[40] The reporting and decision-making structures of such an organization might reflect multidimensional cybernetic network topologies that were previously possible only for computerized systems (or some nonhuman animal species) but which could not be effectively employed within human organizations.[41] Organizational posthumanism can conceptualize such new possibilities and develop

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[38] Horling & Lesser, "A Survey of Multi-Agent Organizational Paradigms" (2004).

[39] For the sake of convenience, it is possible to refer to such developments as 'novel *personnel* structures' – however it must be kept in mind that the 'personnel' constituting such future organizations will not necessarily be human 'persons' but may include, e.g., such radically different types of entities as nanorobot swarms or sapient networks of computerized devices.

[40] Regarding the prospect of creating hive minds and neuroprosthetically facilitated collective intelligence, see, e.g., McIntosh, "The Transhuman Security Dilemma" (2010); Roden, *Posthuman Life: Philosophy at the Edge of the Human* (2014), p. 39; and Gladden, "Utopias and Dystopias as Cybernetic Information Systems: Envisioning the Posthuman Neuropolity" (2015). For a classification of different kinds of potential hive minds, see Chapter 2, "Hive Mind," in Kelly, *Out of Control: The New Biology of Machines, Social Systems and the Economic World* (1994); Kelly, "A Taxonomy of Minds" (2007); Kelly, "The Landscape of Possible Intelligences" (2008); Yonck, "Toward a standard metric of machine intelligence" (2012); and Yampolskiy, "The Universe of Minds" (2014). For critical perspectives on hive minds, see, e.g., Maguire & McGee, "Implantable brain chips? Time for debate" (1999); Bendle, "Teleportation, cyborgs and the posthuman ideology" (2002); and Heylighen, "The Global Brain as a New Utopia" (2002).

[41] See, e.g., Gladden, "Utopias and Dystopias as Cybernetic Information Systems" (2015). Efforts by organizational posthumanists to envision and implement new kinds of posthumanized organizational structures should be distinguished from management approaches such as the Holacracy movement, which abolishes job titles and hierarchical structures for decision-making and authority and replaces them with largely self-organizing, self-guiding circles of employees. From the perspec-

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concrete recommendations regarding organizational structures that are especially well- or poorly suited for organizations comprising posthumanized members.

C. Posthumanized (Information) Systems

The word 'system' is used with different meanings in different organizational contexts. From the perspective of management cybernetics, an organization as a whole can be considered a 'viable system,' as can each of its constituent subsystems.[42] On the other hand, within the context of contemporary organizational architecture, 'systems' are typically computerized information systems such as manufacturing systems that govern and constitute a physical assembly line, an internally hosted accounting database, a cloud-based HR management system, a public-facing website for handling retail transactions, or a social media platform for use in marketing and public relations.

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tive of Holacracy, an organization can essentially be viewed as though it were a conventional electronic computer and each of the organization's human members were components of that computer. The *Holacracy Constitution* provides an organization with a complex set of decision-making rules and procedures that constitute the organization's 'operating system' and which – after this 'OS' has become sufficiently engrained in employees' interactions and decision-making patterns – allow new business processes to be implemented in the form of 'apps' which, in theory, can be downloaded and installed in the minds and behaviors of the organization's human employees in a manner similar to that of installing a new program on a desktop computer. See Robertson, *Holacracy: The New Management System for a Rapidly Changing World* (2015), pp. 9-14, and the *Holacracy Constitution v4.1* (2015).

Superficially, Holacracy shares some elements in common with posthumanism, insofar as it recognizes the fact that innovative new organizational structures that draw inspiration from sources other than traditional human institutions are increasingly becoming possible and even necessary. However, Holacracy diverges from the principles of organizational posthumanism by declining to acknowledge that the circle of intelligent actors within organizations is expanding to include entities other than natural biological human beings. Holacracy is essentially anthropocentric, insofar as it presumes that natural biological human beings are and will continue to be the lone relevant actors within organizations; it simply attempts to induce such human beings to behave as if they were electronic computer components rather than human persons. Such an approach may prove more effective in the future, if implantable computers, neurocybernetics, long-term immersive virtual environments, and other technologizing phenomena lead to the development of human workers that display sufficiently 'computronic' characteristics. (See Part Three of this volume, "The Posthuman Management Matrix: Understanding the Organizational Impact of Radical Biotechnological Convergence," for a discussion of such phenomena.) However, current attempts at implementing approaches such as Holacracy would appear to significantly underestimate the fundamental structural and behavioral differences that presently exist between human and synthetic agents.

[42] For cybernetic accounts of viable systems from a management perspective, see, e.g., Beer, *Brain of the Firm* (1981); Barile et al., "An Introduction to the Viable Systems Approach and Its Contribution to Marketing" (2012); and Gladden, "The Artificial Life-Form as Entrepreneur: Synthetic Organism-Enterprises and the Reconceptualization of Business" (2014).

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Traditionally, the relationship of human employees to such systems has been relatively straightforward: human workers serve as the designers, programmers, data-entry specialists, and end users of the information systems, while the systems themselves are assigned the role of receiving, storing, and transmitting data securely and manipulating it in an efficient and accurate fashion, as instructed by human employees. However, the boundary between the electronic systems that store and process information and the human workers that use them are expected to increasingly blur as implantable computers, neuroprosthetic devices, and persistent virtual reality environments integrate human workers ever more intimately into organizational information systems at both the physical and cognitive levels.[43] Moreover, the growing sophistication of artificial intelligence platforms for use in data mining and other applications[44] is expected to increasingly create information systems that are self-organizing, self-analyzing, and even self-aware. Through the use of such systems, organizations may move beyond the era of Big Data and Smart Data and into an era of 'Sapient Data' in which information systems utilize human workers as tools rather than being utilized by them. Organizational posthumanism can offer critical perspectives regarding both the ontological and ethical aspects of such human-electronic systems as well as their practical implementation.

D. Posthumanized Processes

The essential processes found within an organization do not simply include those by which it directly generates the end products for which the organization is known – such as the actions used to physically assemble some device on an assembly line (for a consumer electronics company) or to generate sounds from musical instruments during a concert (for a symphony orchestra). An organization's fundamental processes also include all of those

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[43] For an in-depth analysis of the ways in which such historical barriers between human workers and electronic information systems are being dissolved, see Part Three of this text, "The Posthuman Management Matrix."

[44] Regarding the prospects of developing autonomous AI systems for data mining, see, for example, Warkentin et al., "The Role of Intelligent Agents and Data Mining in Electronic Partnership Management" (2012); Bannat et al., "Artificial Cognition in Production Systems" (2011), pp. 152-55; and Wasay et al., "Queriosity: Automated Data Exploration" (2015).

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behaviors and dynamics through which resources (including human resources, financial resources, material resources, and information)[45] are acquired from the external environment, created internally, transmitted between different parts of the organization, combined or transformed, or released into the external environment – as well as all of the second-order processes by which those behaviors and dynamics are planned, led, organized, and controlled.[46] Such second-order processes include the use of the three key mechanisms of programming, feedback, and hierarchical supervision to coordinate the activities of an organization's members.[47] They also include compensation and incentive schemes that are used to reward and motivate desired behaviors on the part of an organization's members, as well as processes of career advancement which ensure that an organization's most talented and effective workers move into positions in which their abilities can be employed to their fullest potential.[48]

In the case of contemporary organizations that include only traditional biological human members, there exists a rich body of theory and best practices relating to the design and implementation of such processes. However, it is clear that the nature of these processes can change dramatically within a radically posthumanized organizational context. For example, some kinds of advanced robots and AIs may require no compensation at all – other than 'compensation' in the form of an electric power supply, physical maintenance and software upgrades, and other resources needed to ensure their continued operation. However, very sophisticated AGIs whose cognitive dynamics are based on those of human beings might request – and, as a practical matter, require – compensation in the form of intellectual stimulation, self-fulfillment, and generic financial resources (i.e., a paycheck) that an entity can spend as it sees fit to pursue its own personal goals or objectives in its spare time.[49] Similarly, neurocybernetically augmented human employees may be

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[45] For the role of such resources in organizational dynamics, see, e.g., Pride et al., *Foundations of Business* (2014), p. 8., and Gladden, "The Artificial Life-Form as Entrepreneur" (2014).

[46] Planning, organizing, leading, and controlling are considered to be the four primary functions that must be performed by managers. See Daft, *Management* (2011).

[47] For a review of the scholarship on such mechanisms and their role in organizations, see Puranam et al., "Organization Design: The Epistemic Interdependence Perspective" (2012), p. 431.

[48] See Brickley et al., "Corporate Governance, Ethics, and Organizational Architecture" (2003), p. 43; Puranam et al. (2012); and Nadler & Tushman (1997), loc. 862, 1807.

[49] For an in-depth analysis of the prospects of developing AGIs with human-like cognitive capacities and psychological needs, see Friedenberg, *Artificial Psychology: The Quest for What It Means to Be Human* (2008).

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able to instantly acquire new skills or capacities in ways that render traditional professional advancement schemes outdated and irrelevant, and such employees might demand new forms of compensation (such as lifetime technical support for neuroprosthetic devices that have been implanted to enable the fulfillment of their official organizational responsibilities[50]). Organizational posthumanism can develop theoretical accounts of such posthumanized processes as well as best practices to facilitate their management.

E. Posthumanized Spaces

The physical spaces in which an organization's members come together to plan and execute its activities have historically included venues such as factories, office buildings, warehouses, retail stores, farms, campuses, military bases, and other specialized locations. As organizations evolve and expand to include nonhuman members such as sapient networks or robotic swarms, the range of physical spaces in which such organizational members can (or need) to work will be similarly transformed. Moreover, building on the use of technologies such as telephony, email, instant messaging, and videoconferencing, even the traditional biologically human members of organizations will find themselves interacting in new posthumanized venues such as persistent virtual worlds. Within such new physical and virtual organizational spaces, one member of an organization may or may not always know whether the other intelligent members with which the member is interacting socially are natural biological human beings, neurocybernetically enhanced human beings, robots, AIs, or other kinds of entities.[51] Organizational posthumanism can engage with practitioners in the fields of architecture, facilities design, ergonomics, operations management, and logistics to create and operate posthumanized physical facilities for organizations functioning in such a deanthropocentrized context. With regard to the development and use of posthumanized virtual spaces, organizational posthumanism can provide a conceptual bridge by seeking out insights from fields as diverse as biocybernetics, HCI, psychology, anthropology, communications, philosophy of mind, computer game design, science fiction, and film and television studies to develop immersive multisensory worlds that serve as effective venues for organizational life.

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[50] See Gladden, "Neural Implants as Gateways" (2016).

[51] See Grodzinsky et al. (2011) and Gladden, "The Social Robot as 'Charismatic Leader'" (2014).

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F. Posthumanized External Environments and Ecosystems

An organization can be understood as a viable system that operates within a broader ecosystem (or 'suprasystem') that includes other competing or collaborating organizations as well as natural resources, potential consumers, and other external environmental features.[52] These ecosystems are expected to take on an increasingly posthumanized nature. For example, new environmental elements might include other organizations that consist entirely of intelligent nonhuman members such as robotic swarms and societies of AIs. Similarly, a highly interconnected Internet of Things might be filled with informational resources that are no longer simply passive sets of data but which – through their integration with AI platforms – become intelligent, volitional, and potentially even sapient collections of data that act to pursue their own goals and interests.[53] The world's increasingly rich and complex digital-physical ecosystems might be populated by self-generating, self-propagating, highly adaptable memes in the form of evolvable computer worms or viruses that shape human popular culture as a whole and the thoughts and memories of individual human beings in particular, either through traditional forms of communication and social interaction or through the targeted reprogramming or technological manipulation of, for example, neurocybernetically augmented human beings.[54] The emergence of such new posthuman ecosystems is expected to significantly reshape the kinds of resources that organizations are able to obtain from their environments, the nature of collaboration and competition with external organizations, the types of consumers available to utilize the goods and services produced by an organization, and the organization's definition of long-term viability and success.

The roles that individual organizations play within societies may also be radically reshaped. For example, if future AIs and robotic systems are able to efficiently perform all of the functions of food production and preparation,

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[52] Regarding viable systems and their environments, see, e.g., Beer (1981) and Gladden, "The Artificial Life-Form as Entrepreneur" (2014).

[53] For discussions of the theoretical and practical possibilities for and obstacles to the emergence of such systems, see, e.g., Gladden, "From Stand Alone Complexes to Memetic Warfare: Cultural Cybernetics and the Engineering of Posthuman Popular Culture" (2016), and Gladden, "The Artificial Life-Form as Entrepreneur" (2014).

[54] Regarding the growing possibilities that ideas and other forms of information might exist as actors that can propagate themselves through interaction with other nonhuman or human actors within complex posthumanized digital-physical ecosystems, see, e.g., Gladden, "From Stand Alone Complexes to Memetic Warfare" (2016), and Kowalewska, "Symbionts and Parasites – Digital Ecosystems" (2016).

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health care, education, construction, transportation, energy production, retail sales, accounting, security, and other tasks that are needed for human beings and societies to thrive, there will no longer be a financial or operational need for organizations to employ human beings as workers in such roles. In that case, governments might take on the role of coordinating their human citizens' access to such superabundant resources, perhaps offering a 'universal basic income' redeemable in goods or services. The societal roles of governmental and commercial organizations would thus be dramatically transformed. On the other hand, widespread roboticization resulting in mass unemployment could potentially yield a loss of purpose for human beings, social unrest, violent revolution, and the oppression of the human species by automated systems; in this case, processes of posthumanization might result in 'dystopian' rather than 'utopian' organizational outcomes.[55] Organizational posthumanism can provide a theoretical bridge that links the consideration of posthumanization at an organizational level with that at a broader social or environmental level (as considered by fields such as economics, political science, sociology, evolutionary biology, or environmental science), while also developing concrete practices to aid organizations with optimizing their use of resources from and contribution of products to a posthumanized external environment.

V. Technological Changes Facilitating Organizational Posthumanization

While advanced technologies play an essential role in contemporary processes of posthumanization, they are not the only mechanisms through which such processes operate. As noted earlier, there exist many forms of 'posthumanism without technology.'[56] Such nontechnological critical or cultural posthumanism might focus, for example, on historical references to ghosts, angels, monsters, and semidivine heroes in theology and the arts and the

[55] For the debate on whether mass roboticization and the end of human employment as we know it is likely to generate utopian, dystopian, or less extreme social impacts, see, e.g., Sachs et al., "Robots: Curse or Blessing? A Basic Framework" (2015); Nourbakhsh, "The Coming Robot Dystopia" (2015); and Ford, *Rise of the Robots: Technology and the Threat of a Jobless Future* (2015). For longer-term interdisciplinary perspectives, see the texts in *Singularity Hypotheses*, edited by Eden et al. (2012).

[56] Herbrechter (2013), p. 157.

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ways in which they have long encouraged human beings to expand the boundaries of society to include a nonhuman 'other.'[57]

Posthumanized beings have always been part of organizations. Even if only tangentially, human organizations have always incorporated such quasi-human, parahuman, or nonhuman others. For example, the decision-making processes of Ancient Roman governmental and military organizations relied on augurs that were supposed by their practitioners to reveal the will of the gods.[58] According to the Catholic Church's traditional teaching on the Communion of Saints, the organization of the Church incorporates both human members who are presently living on earth, members who have died but are still undergoing a purification, and members who have died and now contemplate God in His heavenly glory.[59] In a metaphorical sense, the 'ghost' of a company's beloved founder can continue to guide the company's actions even after his or her death, gazing watchfully from framed portraits on office walls and inspiring new generations of employees through aphorisms quoted reverently in the company's mission statement or employee handbook. And nonhuman others in the form of dogs, horses, and other animals have long been incorporated into human military organizations and businesses (e.g., family farms or circuses) in important roles as intelligent – if not sapient – agents.

Technologization is changing the nature of posthumanization. However, even critical posthumanists who argue that the processes of posthumanization have historically taken many forms unrelated to technological change will acknowledge that in today's world, the accelerating and intensifying technologization of humanity has become an essential – if not the most essential – driver of posthumanization.[60] Herbrechter notes that from the time of its prehistoric origins, humanity has always utilized technology. Indeed, it was only the creation of techniques and technologies for performing such tasks as making fire, hunting animals, and communicating information symbolically that humankind as such was able to develop; "Culture in a sense is therefore always 'technoculture', namely achieved and transmitted by technics."[61] However, the manner and extent of our integration with workplace

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[57] Herbrechter (2013), pp. 2-3, 106. See also Graham (2002).

[58] See Hamilton, "What Is Roman Ornithomancy? A Compositional Analysis of an Ancient Roman Ritual" (2007), and Green, "Malevolent gods and Promethean birds: Contesting augury in Augustus's Rome" (2009).

[59] See the *Catechism of the Catholic Church, Second Edition* (2016), pp. 249-250.

[60] See Herbrechter (2013), pp. 15, 6-7.

[61] Herbrechter (2013), p. 152.

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technologies is now undergoing a qualitative transformation. Herbrechter suggests that the human operators of equipment are increasingly merging with their tools in order to manipulate them more effectively, thereby undergoing a process of cyborgization. But just as we are becoming more dependent on our technology, our technology is becoming less dependent on us – thanks to the growing sophistication of artificial intelligence and automated systems that can make decisions without any need for human input. Human agency is thus being attenuated by technology at the same time that the world of 'smart objects' is gaining its own agency.[62]

The new kinds of posthumanized beings produced through such technologization will become incorporated into human organizations in novel fashions. A ghost or saint or animal can indeed be 'incorporated' into the life and behaviors of an organization in meaningful ways – but not, for example, as an employee of the organization. The 'ghost' of a company's founder might offer vague principles to guide decision-making but cannot determine which of three smartphone models to offer for sale in a particular country. A horse can transport a company's goods from place to place but cannot formulate the company's long-term business strategy. However, posthuman beings in the form of artificial intelligences, social robots, sentient (and even sapient) networks, and cyborgs *will* be able to do such things. Increasingly, such posthumanized entities will not simply operate at the fringes of an organization or in supporting roles that aid the decision-making of the organization's natural human members; such posthuman beings will instead increasingly fill critical roles as designers, producers, strategists, and decision-makers within organizations.[63]

While processes such as roboticization, cyborgization, and virtualization have not created the phenomenon of posthumanization, they are making its dynamics visible in new and more vivid ways.[64] Hayles suggests that some forms of 'uncritical' posthumanism (including strains of transhumanism and cybernetics) possess a naïvely technologized interpretation of these processes: such a perspective understands the human body as merely a prosthesis or computational substrate and the mind as a collection of informational patterns; it considers the biological organism of a human being, a social robot

[62] For a discussion of these simultaneous trends, see Herbrechter (2013), p. 150.

[63] An exploration of these possibilities can be found, e.g., in Samani et al. (2012) and Gladden, "The Social Robot as 'Charismatic Leader'" (2014).

[64] See Herbrechter (2013), p. 77.

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resembling a human being, and a computer simulation of a human being to be just three interchangeable manifestations of the same sort of viable system.[65] Critical posthumanists such as Hayles and Herbrechter reject such simplistic 'technoeuphoria' and argue that more rigorous critical posthumanist thought is necessary in order to understand, anticipate, and guide the processes of sociotechnological transformation that are challenging our concept of humanity and altering humanity's role in the world.[66] Organizational posthumanism is well-positioned to explore such questions of technological posthumanization in a way that marries the circumspectness of critical posthumanism with a strategic awareness of the fact that the ability to generate and embrace radical new forms of technological transformation is growing ever more important to the survival of organizations.

Three categories of posthumanizing technologies. For the purposes of this text, there are three broad categories of ongoing or anticipated technological developments that are contributing to posthumanization in especially relevant ways: 1) technologies for human augmentation and enhancement, which include many forms of neuroprosthetics and genetic engineering; 2) technologies for synthetic agency, which include robotics, artificial intelligence, and artificial life; and 3) technologies for digital-physical ecosystems and networks that help create the environments within which and infrastructure through which human and artificial agents will interact.[67] We can consider these three types of technologies in turn.

A. Technologies for Human Augmentation and Enhancement

Technologies that are expected to alter the sensory, motor, and cognitive capacities of human beings include implantable computers, advanced neuro-

[65] See Hayles (1999), pp. 2-3, and its discussion in Herbrechter (2013), p. 42.

[66] Herbrechter (2013), p. 200.

[67] For a discussion of the role of such technologies in posthumanization, see Herbrechter (2013), pp. 90-91, and its analysis of Graham (2002) and Graham, "Post/Human Conditions" (2004). Note that while we focus in this text on three kinds of posthumanizing technologization that have a particular impact on the form and dynamics of organizations, they are by no means the only kinds of technologization that will contribute to posthumanization. Technological developments in other fields such as agriculture, transportation, energy, space exploration, and the military will also likely contribute to the posthumanization of our world and the organizations within it.

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prosthetics, genetic engineering, and the use of immersive virtual reality systems.[68] The implementation of such technologies will result in a posthumanization of organizations' **members** (e.g., as an organization purposefully hires cyborgs to fill particular roles or the organization's current employees acquire cybernetic enhancements on their own initiative), **structures** (e.g., as implantable computers and communication devices allow workers to engage in new types of decision-making and reporting relationships), **systems** (e.g., by giving human workers new abilities to control, be controlled by, and otherwise interface with an organization's technological infrastructure), **processes** (e.g., by facilitating direct brain-to-brain communication and providing workers with in-body access to organizational databases), **spaces** (e.g., by allowing cyborg workers to operate in areas dangerous or inaccessible to natural human beings), and **external ecosystems** (e.g., by creating cyborg consumers that need new kinds of goods and services and external cyborg partners and consultants that can provide them). We can consider such posthumanizing technologies in more detail.

1. Implantable Computers

The universe of contemporary information and communications technology (ICT) includes a wide range of implantable devices such as passive RFID tags that are not in themselves computers but which can interact with computers and serve as elements of computerized systems. However, an increasing number of implantable devices indeed constitute full-fledged computers that possess their own processor, memory, software, and input/output mechanisms and whose programming can be updated after they are implanted into the body of their human host. Among these are many implantable medical devices (IMDs) such as pacemakers, defibrillators, neuroprostheses including retinal and cochlear implants, deep brain stimulation (DBS) devices, body sensor networks (BSNs), and even some of the more sophisticated implantable RFID transponders.[69] A growing number of these implantable computers utilize sophisticated biocybernetic control loops that allow the

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[68] Such technologies are reviewed, e.g., in Bostrom (2008); Fukuyama (2002); Gray (2002); and Herbrechter (2013), pp. 90-91.

[69] See Gasson et al., "Human ICT Implants: From Invasive to Pervasive" (2012); Gasson, "ICT Implants" (2008); and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 19-20.

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physiological and cognitive activity of their host to be detected, processed, and interpreted for use in exercising real-time computer control.[70]

The implantable computers that have been developed to date typically serve a restorative or therapeutic medical purpose: they are used to treat a particular illness or restore to their user a sensory, motor, or cognitive ability that has been lost through illness or injury. Increasingly, though, implantable computers will be developed not to restore some regular human capacity that has been lost but to augment their users' physical or intellectual capacities in ways that exceed typical human abilities.[71] For example, implantable computers resembling miniaturized subcutaneous smartphones might provide their users with wireless communication capacities including access to cloud-based services.[72] The elective use of implantable computers for physical and cognitive augmentation will expand the market for such devices to broader segments of the population beyond those who currently rely on them to address medical conditions.[73]

2. Advanced Neuroprosthetics

Drawing on definitions offered by Lebedev and others, we can define a neuroprosthesis as a technological device that is integrated into the neural circuitry of a human being; such devices are often categorized as being sensory, motor, bidirectional sensorimotor, or cognitive.[74] While there is much overlap between implantable computers and neuroprosthetic devices, not all implantable computers interface directly with their host's neural circuitry and not all neuroprosthetic devices are implantable.[75]

The power and potential applications of neuroprosthetic devices are expected to grow significantly in the coming years. For example, it is anticipated

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[70] See Fairclough, "Physiological Computing: Interfacing with the Human Nervous System" (2010), and Park et al., "The Future of Neural Interface Technology" (2009).

[71] Regarding the anticipated increasing use of implantable computers for purposes of human enhancement, see, e.g., Warwick & Gasson, "Implantable Computing" (2008); Berner (2004), p. 17; and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 28.

[72] For discussion of such a device, see Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 93.

[73] See McGee (2008) and Gasson et al. (2012).

[74] Such a classification is discussed in Lebedev, "Brain-Machine Interfaces: An Overview" (2014), and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 21-22.

[75] For this distinction, see Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 32.

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that current types of retinal implants that demonstrate very limited functionality will be supplanted by future sensory neuroprosthetics such as artificial eyes[76] that give their human hosts the capacity to experience their environments in dramatic new ways, such as through the use of telescopic or night vision[77] or by presenting an augmented reality that overlays actual sense data with supplemental information from a neuroprosthetic device's computer.[78] A neuroprosthetic device could also allow all of the sense data experienced by a human mind to be recorded as a stream of digital data that can be played back on demand by other human beings, enabling them to vicariously experience the world as though they were temporarily occupying the body of the device's host. Similar technologies might allow a person to play back any of his or her own earlier sensory experiences with perfect fidelity or replace the sense data generated by his or her actual external environment with sense data depicting some fictional virtual world.[79]

Meanwhile, cognitive neuroprosthetic devices may offer their user the ability to create, delete, or otherwise edit memories stored within his or her brain's biological neural network; such abilities could be used, for example, to acquire new knowledge or skills or to erase existing fears.[80] Some scholars envision the development of ingestible 'knowledge pills' whose contents (perhaps a swarm of networked nanorobots[81]) travel to the brain, where they manipulate neurons to create engrams containing particular memories.[82] Other researchers foresee the possibility of being able to simply download new

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[76] Regarding such possibilities, see Berner (2004), p. 17, and Koops & Leenes (2012).

[77] Such enhanced forms of vision are discussed, e.g., in Gasson et al. (2012) and Merkel et al., "Central Neural Prostheses" (2007).

[78] See Koops & Leenes (2012) and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 32-33.

[79] Regarding such sensory playback and virtual reality systems, see Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 33, 156-57; Koops & Leenes (2012), pp. 115, 120, 126; Merkel et al. (2007); Robinett, "The Consequences of Fully Understanding the Brain" (2002); and McGee (2008), p. 217.

[80] Such possibilities build on experimental techniques and technologies that are currently being tested in mice. See Han et al., "Selective Erasure of a Fear Memory" (2009); Ramirez et al., "Creating a False Memory in the Hippocampus" (2013); McGee (2008); Warwick, "The Cyborg Revolution" (2014), p. 267; and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 148.

[81] See Pearce, "The Biointelligence Explosion" (2012).

[82] For such possibilities, see Spohrer, "NBICS (Nano-Bio-Info-Cogno-Socio) Convergence to Improve Human Performance: Opportunities and Challenges" (2002).

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skills or knowledge onto a memory chip implanted within the brain.[83] Cognitive neuroprosthetic devices might also be used to provide their human hosts with enhanced levels of intelligence[84] and creativity,[85] more desirable emotional dynamics and behavior,[86] enhanced conscious awareness (e.g., by reducing the need for sleep),[87] a strengthened or modified conscience,[88] and real-time assistance with decision-making to mitigate the impact of cognitive biases.[89]

Similarly, a motor neuroprosthetic device might grant its user enhanced control over his or her existing biological body, expand the user's body to incorporate new devices (such as an exoskeleton or robotic vehicle) through body schema engineering, replace most of the user's existing biological body with electromechanical components to turn the individual into a cyborg,[90] allow the user to control external networked physical systems such as drones

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[83] See McGee (2008) and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 33.

[84] Berner (2004), p. 17.

[85] Increases in creativity have been anecdotally reported to occur after the use of neuroprosthetics for deep brain stimulation. See Cosgrove, "Session 6: Neuroscience, brain, and behavior V: Deep brain stimulation" (2004); Gasson, "Human ICT Implants: From Restorative Application to Human Enhancement" (2012); Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 149; Gladden, "Neural Implants as Gateways" (2016); and Gasson (2012), pp. 23-24.

[86] Regarding the intentional creation of emotional neuroprosthetics, see, e.g., Soussou & Berger, "Cognitive and Emotional Neuroprostheses" (2008). Effects on emotion have already been observed, for example, with devices used for deep brain stimulation. See Kraemer, "Me, Myself and My Brain Implant: Deep Brain Stimulation Raises Questions of Personal Authenticity and Alienation" (2011).

[87] Regarding efforts by the DARPA military research agency and others to develop neurotechnologies that can increase soldiers' alertness and reduce their need for sleep, see, e.g., Falconer, "Defense Research Agency Seeks to Create Supersoldiers" (2003); Moreno, "DARPA On Your Mind" (2004); Clancy, "At Military's Behest, Darpa Uses Neuroscience to Harness Brain Power" (2006); Wolf-Meyer, "Fantasies of extremes: Sports, war and the science of sleep" (2009); Kourany, "Human Enhancement: Making the Debate More Productive" (2013), pp. 992-93; and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), p. 151.

[88] The conscience can be understood as a set of metavolitions, or desires about the kinds of volitions that a person wishes to possess. See Calverley (2008) and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 151-52. To the extent that a neuroprosthetic device enhances processes of memory and emotion that allow for the development of the conscience, it may enhance one's ability to develop, discern, and follow one's conscience.

[89] Regarding the potential use of neuroprosthetic devices for such purposes, see Gladden, "Neural Implants as Gateways" (2016). For a description of common cognitive biases and their impact on organizational decision-making, see Kinicki & Williams, *Management: A Practical Introduction* (2010), pp. 217-19.

[90] See Lebedev (2014) and Berner (2004), p. 16.

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or 3D printers, or provide the host with a radically nonhuman body for use in sensing and manipulating a virtual environment.[91]

3. Virtual Reality

In principle, a virtual reality system may be capable of creating a fully immersive visual, auditory, olfactory, gustatory, and tactile environment that its human user would find impossible to qualitatively distinguish from the real world, if the system is capable of presenting either roughly 200 Gbps of raw sense data to the body's sensory organs (such as the retina, hair cells in the ear, and taste buds) through their external stimulation or roughly 250 Mbps of already-processed sense data in the form of direct electrochemical stimulation either of the nerves (such as the optic and cochlear nerves) that carry such data to the brain or of the relevant brain regions themselves.[92] Such fully immersive – and potentially continuous and long-term – virtual reality experiences could be facilitated through the use of advanced neuroprosthetic devices that provide a human brain with all of its sense data, perhaps aided by the use of genetic engineering to make the brain or sensory organs better suited to receive input from such devices.[93]

There is no logical necessity for these fully immersive virtual worlds to resemble our real world in all respects: within a virtual world, human beings might be given new kinds of sensory capacities[94] or even radically nonhuman bodies.[95] Moreover, the laws of physics and biology that hold sway within the real world need not apply in a virtual world; the designers of such worlds could formulate their own cultural, social, biological, physical, and even logical and ontological principles that govern or mediate the interactions of subjects and objects within a virtual world. For example, a world designer might decide that within a particular virtual world all human beings, all computers possessing artificial general intelligence, and some of the more intelligent

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[91] Gladden, "Cybershells, Shapeshifting, and Neuroprosthetics: Video Games as Tools for Posthuman 'Body Schema (Re)Engineering'" (2015).

[92] See Berner (2004), pp. 37-38, 45-47.

[93] On implantable systems for augmented or virtual reality, see Sandor et al., "Breaking the Barriers to True Augmented Reality" (2015), pp. 5-6. Regarding the theoretical possibilities and limits of such technologies, taking into account human physiological and psychological constraints, see Gladden, "Cybershells, Shapeshifting, and Neuroprosthetics" (2015).

[94] See Merkel et al. (2007).

[95] Such possibilities are explored in Gladden, "Cybershells, Shapeshifting, and Neuroprosthetics" (2015).

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forms of animals represented within it are able to instantaneously share their thoughts and emotions with one another through a form of 'telepathy,' thereby creating new kinds of communal creativity, thought, and agency.[96]

Such technologies could potentially have significant negative consequences; for example, particularly immersive and stimulating virtual environments may become addictive, with their users unable or unwilling to leave them.[97] Moreover, if a user possesses a permanently implanted virtual reality device that is able to alter or replaces its host's sensory perceptions, it may be impossible for the user to know which (if any) of the sense data that he or she is experiencing corresponds to some actual element of an external physical environment and which is 'virtual' or simply 'false'; such an individual may lose the ability (and perhaps desire) to distinguish between real and virtual experiences and worlds.[98]

4. Genetic Engineering, Medicine, and Life Extension

Notwithstanding the many serious questions about whether such applications are ontologically coherent and ethically acceptable, as a practical matter scholars expect that new techniques for genetic engineering will eventually be used, for example, to produce a continually refreshed inventory of personalized replacement organs that can be implanted when their human host's previous organs 'wear out' – or even organs that regenerate themselves

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[96] Such options available to the designers of virtual worlds in immersive and long-term multisensory VR environments are discussed in Gladden, "Cybershells, Shapeshifting, and Neuroprosthetics" (2015), and Gladden, "'Upgrading' the Human Entity: Cyberization as a Path to Posthuman Utopia or Digital Annihilation?" (2015).

[97] Regarding the ramifications of long-term immersion in virtual reality environments, see, e.g., Heim, *The Metaphysics of Virtual Reality* (1993); Koltko-Rivera, "The potential societal impact of virtual reality" (2005); and Bainbridge, *The Virtual Future* (2011). Regarding the danger of 'toxic immersion' in a virtual world, see Castronova, *Synthetic Worlds: The Business and Culture of Online Games* (2005). See also Berner (2004), p. 16, and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 55-56.

[98] For the possibility that a device designed to receive raw data from an external environment could have that data replaced with other data transmitted from some external information system, see Koops & Leenes (2012). Regarding the possibility of neuroprosthetic devices being used to provide false data or information to their hosts or users, see McGee (2008), p. 221, and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015). For an analysis of the relationship between physical and virtual reality and ways in which entities can move between these worlds, see Kedzior, "How Digital Worlds Become Material: An Ethnographic and Netnographic Investigation in Second Life" (2014). For more general analyses of the phenomenon of virtual reality, see, e.g., *Communication in the Age of Virtual Reality*, edited by Biocca & Levy (1995); *Cybersociety 2.0: Revisiting Computer-Mediated Communication and Community*, edited by Jones (1998); and Lyon, "Beyond Cyberspace: Digital Dreams and Social Bodies" (2001).

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within their host's body.[99] It is also anticipated that gene therapy will be employed not simply to replace damaged body components with healthy replicas but to modify the form and functioning of an individual's body or to create new human beings who possess particularly desirable characteristics.[100]

Some scholars expect that the use of medical technologies for radical life extension will become more widespread even as the availability of such technologies remains restricted for legal, ethical, financial, or cultural reasons. Those individuals who possess access to such technologies may be allowed to extend their life indefinitely (in whatever form such a life might take) and may be permitted and expected to choose the time of their own death.[101]

Genetic engineering may also be used to create new forms of sensory, motor, or computing devices within the human body. For example, a neuroprosthetic device need not be electronic in nature: ongoing developments in fields such as genetic engineering, synthetic biology, bionanotechnology, and biomolecular computing are expected to make possible the creation of neuroprosthetic devices that are partially or wholly composed of biological material (perhaps based on the DNA of the device's host) or other non-electronic components.[102] Other advances in medical technology may involve the use of more traditional electronics and robotics. For example, a swarm of nanorobots that has been injected or ingested may travel to a specific location within the body to perform surgery, clean clogged arteries, or modify or stimulate neurons to

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[99] See Berner (2004), p. 61, and Ferrando (2013), p. 27.

[100] For a range of perspectives on such possibilities, see, e.g., Berner (2004), p. 17; Panno, *Gene Therapy: Treating Disease by Repairing Genes* (2005); Mehlman, *Transhumanist Dreams and Dystopian Nightmares: The Promise and Peril of Genetic Engineering* (2012); Bostrom, "Human Genetic Enhancements: A Transhumanist Perspective" (2012); Lilley, *Transhumanism and Society: The Social Debate over Human Enhancement* (2013); and De Melo-Martín, "Genetically Modified Organisms (GMOs): Human Beings" (2015).

[101] For a discussion of various approaches to human life extension, see Koene, "Embracing Competitive Balance: The Case for Substrate-Independent Minds and Whole Brain Emulation" (2012). See also Berner (2004), pp. 16-17, and Ferrando (2013), p. 27.

[102] Such technologies are discussed, e.g., in Ummat et al., "Bionanorobotics: A Field Inspired by Nature" (2005); Andrianantoandro et al., "Synthetic biology: new engineering rules for an emerging discipline" (2006); Cheng & Lu, "Synthetic biology: an emerging engineering discipline" (2012); Lamm & Unger, *Biological Computation* (2011); and Berner (2004), pp. 15, 18, 31, 61-62. For a hybrid biological-electronic interface device that includes a network of cultured neurons, see Rutten et al., "Neural Networks on Chemically Patterned Electrode Arrays: Towards a Cultured Probe" (2007). Hybrid biological-electronic interface devices are also discussed by Stieglitz in "Restoration of Neurological Functions by Neuroprosthetic Technologies: Future Prospects and Trends towards Micro-, Nano-, and Biohybrid Systems" (2007).

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create new information within neural networks.[103] Ingestible robotic pills might be used to evaluate an individual's internal biological processes and to administer precise dosages of drugs according to complex criteria.[104]

More futuristic and contentious is the concept of 'mind uploading' as a means of extending the life (or if not the life, then in some sense the 'agency') of a particular human being by somehow copying or transferring the structures and processes of his or her mind from their original biological substrate to a new electronic form – for example, by gradually replacing all of a brain's original biological neurons with electronic artificial neurons. Many scholars argue that while it may, for example, be possible to copy the data that comprise the contents of a mind's memories to some external system, it is impossible to transfer or extend the conscious awareness of the mind itself in such a fashion. Nevertheless, some transhumanist proponents of mind uploading argue that such a process would not truly destroy the consciousness or essence of its human host – and that even if it did, they would be willing to transform their own bodies in this fashion, insofar as it might provide a bridge that would allow them to duplicate their memories and patterns of mental activity in a robotic or computerized body that could survive indefinitely.[105]

B. Technologies for Synthetic Agency: Robotics, AI, and Artificial Life

Ongoing rapid developments are expected in those fields such as robotics, artificial intelligence, and artificial life that involve the creation of entities that possess artificial agency and which are able to receive data from their environment, process information, select a course of action, and act to influence their world. For example, research within the field of artificial intelligence is expected to yield artificial agents that possess human-like levels of intelligence, creativity, learning capacity, sociality, and cultural knowledge

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[103] Medical and other applications of such technologies are discussed in Spohrer (2002); Berner (2004), pp. 18, 76; Pearce (2012); and Ferrando (2013), p. 27.

[104] Berner (2004), p. 76.

[105] For different perspectives on techniques such as the use of artificial neurons to gradually replace the natural biological neurons within a living human brain as a means of effecting 'mind uploading,' see Moravec, *Mind Children: The Future of Robot and Human Intelligence* (1990); Hanson, "If uploads come first: The crack of a future dawn" (1994); Proudfoot, "Software Immortals: Science or Faith?" (2012); Koene (2012); Pearce (2012); and Ferrando (2013), p. 27.

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and which will eventually claim to possess consciousness and their own spirituality.[106] Such artificial agents might be capable of serving as charismatic leaders of human beings by utilizing their powers of persuasion, inspiration, and interpersonal attractiveness,[107] and they may be able to draw on their social capacities and cultural knowledge to serve, for example, as the managers of vast global virtual teams of human workers.[108]

Significant changes are also expected regarding the physical substrates upon which robots and AI platforms are based, as it becomes possible to design systems utilizing components that are increasingly miniaturized, spatially dispersed, and biological; no longer will an artificially intelligent software-based system be chained to the electronic physical substrate found in traditional computers.[109] Entirely new kinds of robots and AI systems may become possible thanks to emerging technologies for physical neural networks,[110] photonic computing, quantum computing, the use of DNA for digital data storage and computing, and other kinds of biocomputing.[111] Thanks to advances in nanorobotics, robots will come to outnumber human beings and

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[106] Regarding the prospect of robots and AIs that possess truly human-like cognitive capacities, see Friedenberg (2008) and Berner (2004), pp. 16-17, 38. For discussion of robots that interact socially with human beings, see Breazeal, "Toward sociable robots" (2003); Kanda and Ishiguro, *Human-Robot Interaction in Social Robotics* (2013); *Social Robots and the Future of Social Relations*, edited by Seibt et al. (2014); *Social Robots from a Human Perspective*, edited by Vincent et al. (2015); and *Social Robots: Boundaries, Potential, Challenges*, edited by Nørskov (2016). Regarding elements that must be present in order for a computerized device to develop its own spirituality, see, e.g., Geraci, "Spiritual robots: Religion and our scientific view of the natural world" (2006); Nahin, "Religious Robots" (2014); and Section 6.2.3.2 on "Religion for Robots" in Yampolskiy, *Artificial Superintelligence: A Futuristic Approach* (2015).

[107] See Gladden, "The Social Robot as 'Charismatic Leader'" (2014).

[108] Regarding potential managerial roles for robots and AIs, see Samani & Cheok, "From human-robot relationship to robot-based leadership" (2011); Samani et al. (2012); and Gladden, "Leveraging the Cross-Cultural Capacities of Artificial Agents" (2014). Regarding the possibility of 'supersocial' AIs that can simultaneously maintain social relations with massive numbers of human colleagues or subordinates, see, e.g., Gladden, "Managerial Robotics" (2014).

[109] Regarding the evolving physical form of robots, see, e.g., Gladden, "The Diffuse Intelligent Other" (2016), and Berner (2004), p. 16.

[110] Regarding AIs that utilize physical neural networks rather than running as an executable software program on a conventional computer employing a Von Neumann architecture, see, e.g., Snider, "Cortical Computing with Memristive Nanodevices" (2008); Versace & Chandler, "The Brain of a New Machine" (2010); and *Advances in Neuromorphic Memristor Science and Applications*, edited by Kozma et al. (2012).

[111] For discussion of DNA-based and biological computing, see, e.g., Berner (2004), pp. 15, 18, 31, 61-62; Ummat et al. (2005); Andrianantoandro et al. (2006); Lamm & Unger (2011); Church et al., "Next-generation digital information storage in DNA" (2012); and Cheng & Lu (2012).

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become truly ubiquitous: through the use of piezoelectric components, nanoscale switches and sensors can be created that require no electrical power source, allowing clouds of nanorobots to float on the air and fill the space around us with an invisible mesh of sensors, actuators, and information-processors.[112] Such swarms of customized nanorobots might be sent into dangerous environments to aid with disaster relief or to conduct military operations,[113] and moving beyond today's relatively simple 3D printing systems, portable (perhaps even handheld) manufacturing facilities could be created that employ specialized swarms of nanorobots to produce highly sophisticated physical goods.[114]

Ongoing developments in the fields of synthetic biology, bionanotechnology, biologically inspired robotics, soft robotics, evolutionary robotics, and artificial life are expected to result in robotic systems whose structures and dynamics resemble those of living organisms and ecosystems or are even composed of biological material. For example, researchers envision the development of robotic systems controlled not by a traditional CPU-based computer but by a synthetic brain;[115] autonomous robots that can learn, adapt, reproduce themselves, and evolve through competition for resources within a digital-physical ecosystem;[116] autonomous computer networks that function as a living entity[117] that possesses its own immune system and whose remaining networked components are able to automatically take over the work of a member computer that has been disconnected or destroyed;[118] and software programs that can repair damage to themselves or even reprogram themselves to accomplish a new purpose, as well as computer chips or entire ro-

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[112] Berner (2004), pp. 16, 18, 38, 40-41.

[113] See Coeckelbergh, "From Killer Machines to Doctrines and Swarms, or Why Ethics of Military Robotics Is Not (Necessarily) About Robots" (2011), and Berner (2004), pp. 16-17.

[114] Berner (2004), p. 17.

[115] See Warwick (2014) and Berner (2004), p. 17.

[116] See Gladden, "The Artificial Life-Form as Entrepreneur" (2014), and Berner (2004), pp. 16, 18.

[117] Regarding collectively conscious computer networks, see Callaghan, "Micro-Futures" (2014). For a future Internet that is technically 'self-aware' (if not subjectively conscious), see Galis et al., "Management Architecture and Systems for Future Internet Networks" (2009), pp. 112-13. A sentient Internet is also discussed in Porterfield, "Be Aware of Your Inner Zombie" (2010), p. 19. For a future Internet whose degree of self-awareness resembles that of a living entity, see Hazen, "What is life?" (2006). See also Gladden, "The Artificial Life-Form as Entrepreneur" (2014).

[118] See Berner (2004), pp. 17, 31.

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bots that can intentionally repair or automatically heal damage to themselves.[119] Emerging technologies are expected to eventually allow the development of 'biological operating systems' for groups of cells and entire organisms as well as the design of entirely new species[120] that could be understood alternatively as either artificial biological organisms or biological robots.

Together, technologies that create advanced synthetic agents such as social robots, artificial general intelligences, and artificial life-forms are expected to drive an ongoing posthumanization of organizations' **members** (e.g., by allowing such nonhuman entities to serve as organizational members alongside or instead of human beings), **structures** (e.g., by allowing optimized decision-making and reporting structures designed through genetic algorithms that are free from human cognitive biases and limitations), **systems** (e.g., by allowing the development of organizational systems that are operated by synthetic beings with high speed and accuracy, without the need for human workers to enter data or access information through the slow and error-prone processes of reading printed text), **processes** (e.g., by allowing an organization's synthetic members to analyze data and make decisions faster, more accurately, or more imaginatively than is possible for human beings), **spaces** (e.g., by eliminating the need for physical facilities whose atmosphere, temperature, radiation levels, and other characteristics can sustain human life), and **external ecosystems** (e.g., by creating external resource-providers and consumers that are synthetic beings whose needs and capacities differ widely from those of human beings).

C. Technologies for Digital-Physical Ecosystems and Networks: Connectivity, Relationships, and Knowledge

Many technological changes are either underway or expected that do not relate exclusively to human or artificial agents but which instead shape the larger networks and ecosystems within which all intelligent agents interact. Through the incorporation into the Internet of all public knowledge that has been generated by the human species, the expansion of the Internet of Things

[119] Berner (2004), pp. 17-18. Regarding self-maintenance and self-healing as one capacity that robotic systems must possess in order to be fully autonomous, see Gladden, "The Diffuse Intelligent Other" (2016).

[120] Berner (2004), pp. 16, 61. See also the discussion in Friedenberg (2008), pp. 201-03, of essential elements that must be present in order for an artificial entity to be 'alive,' which are based on the criteria for biological life presented in Curtis, *Biology* (1983).

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to encompass a growing variety and number of networked devices (including ubiquitous sensors conducting real-time surveillance),[121] and the use of RFID or other technologies to assign a unique identifier to any physical object, cyberspace can in effect become a virtual representation of the entire world.[122] Successor networks to the current-day Internet may serve as a mesh that creates a digital-physical ecosystem tying together all kinds of intelligent agents that are able to access the network through biological, electronic, or other means, including unmodified 'natural' human beings, genetically engineered human beings, human beings with extensive cybernetic augmentations, human minds that dwell permanently within virtual realities, social robots, artificially intelligent software, nanorobot swarms, and sapient networks.[123] Within such vast, complex digital ecosystems, most communication will no longer involve human beings but will take place between networked devices,[124] as real-time data mining is performed by automated systems to continually unearth new theoretical, historical, and predictive knowledge.[125] Some researchers expect that so close will be the symbiotic[126] integration of computerized networks with their natural environment that it may be possible to 'reboot' entire ecosystems as needed, in order to save or improve the lives of their inhabitants.[127]

In particular, neuroprosthetic devices may serve as gateways that unite the human and electronic inhabitants of a digital-physical ecosystem, allowing their human hosts to participate in new kinds of technologically mediated

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[121] This evolution in the Internet of Things is discussed in Evans, "The Internet of Everything: How More Relevant and Valuable Connections Will Change the World" (2012).

[122] See Berner (2004), pp. 18, 35, and Gladden, "Utopias and Dystopias as Cybernetic Information Systems" (2015).

[123] Cybernetic networks that can link such entities are discussed in Gladden, "Utopias and Dystopias as Cybernetic Information Systems" (2015).

[124] See Berner (2004), p. 18, and Evans (2012).

[125] See Berner (2004), p. 32. Existing semi-automated data-mining processes are described, e.g., in Giudici, *Applied Data Mining: Statistical Methods for Business and Industry* (2003), and Provost & Fawcett, *Data Science for Business* (2013), p. 7. Regarding the prospects of developing more fully autonomous AI systems for data mining, see, for example, Warkentin et al. (2012); Bannat et al. (2011), pp. 152-55; and Wasay et al. (2015).

[126] For a philosophical exploration (drawing on Actor-Network Theory) of ways in which nonhuman and human actors coexisting within digital-physical ecosystems might enter into 'symbioses' that are not simply metaphorical but are instead true symbiotic relationships, see Kowalewska (2016).

[127] This possibility is raised in Berner (2004), p. 16.

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social relations and structures that were previously impossible – perhaps including new forms of merged agency[128] or cybernetic networks that display utopian (or dystopian) characteristics that are not possible for non-neuroprosthetically-enabled societies.[129] Neuroprosthetic devices may also link hosts or users in ways that form communication and information systems[130] that can generate greater collective knowledge, skills, and wisdom than are possessed by any individual member of the system.[131] Because this ubiquitous digital-physical mesh of networked neuroprosthetic devices, sensors, actuators, data pools, and servers will allow human and synthetic minds to exchange thoughts with one another in a manner that seems direct, instantaneous, and unmediated and to control physical systems and objects and virtual environments, it will create what is, for practical purposes, a 'quasi-magical' world in which beings demonstrate functional telepathy and telekinesis.[132]

Such technological change will not only result in a posthumanization of the larger **external ecosystems** within which organizations exist; it will also spur an ongoing posthumanization of organizations' **members** (e.g., by increasing or decreasing members' sensory input, span of motor control, and social interaction with other intelligent nodes within the environment), **structures** (e.g., by allowing decision-making and reporting relations to be overlaid on top of naturally existing cybernetic relationships created between members within the environment), **systems** (e.g., by providing free or fee-based public information systems that can be utilized by an organization), **processes** (e.g., by allowing an organization to develop its own customized processes or exploit SaaS-based approaches that utilize the environment's publically ac-

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[128] See McGee (2008), p. 216, and Koops & Leenes (2012), pp. 125, 132.

[129] Different forms that such societies might take are discussed in Gladden, "Utopias and Dystopias as Cybernetic Information Systems" (2015).

[130] The intentional or *ad hoc* creation of such systems is discussed, e.g., in McGee (2008), p. 214; Koops & Leenes (2012), pp. 128-29; Gasson (2012), p. 24; and Gladden, "'Upgrading' the Human Entity" (2015).

[131] The dynamics through which this can occur are discussed, e.g., in Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (1961), loc. 307off., 3149ff.; Gladden, "Utopias and Dystopias as Cybernetic Information Systems" (2015); and Gladden, *The Handbook of Information Security for Advanced Neuroprosthetics* (2015), pp. 160-61.

[132] See Berner (2004), pp. 16-17, 38; Gladden, "Cybershells, Shapeshifting, and Neuroprosthetics" (2015); and the potential indistinguishability of advanced technology and magic, as famously discussed in Clarke, "Hazards of Prophecy: The Failure of Imagination" (1973), p. 36.

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cessible cloud infrastructure), and **spaces** (e.g., by creating ready-made physical and virtual spaces that an organization can move into and adapt for its own ends).

VI. Conclusion

The relationship of posthumanist thought to organizational studies and management is a topic that is increasingly worth exploring, thanks largely to the ongoing acceleration and intensification of technological change that is fashioning a new organizational context which can appropriately be described as 'posthuman.' Within this text, we have attempted to advance the development of this new sphere of academic inquiry and management practice by presenting one approach to formulating a systematic organizational posthumanism.

We began by noting that established forms of posthumanism could be divided into analytic types that view posthumanity as an existing sociotechnological reality that is best understood from a post-dualist and post-anthropocentric perspective and synthetic types that view posthumanity as a kind of future entity whose creation can either be intentionally brought about or avoided. Similarly, established forms of posthumanism can be understood as either theoretical or practical in nature, depending on whether their goal is to expand human knowledge or generate some concrete impact in the world. We have argued that organizational posthumanism combines analytic, synthetic, theoretical, and practical elements as a type of hybrid posthumanism. It is analytic and theoretical insofar as it attempts to identify and understand the ways in which contemporary organizations' structures and dynamics are being affected by emerging sociotechnological realities, and it is synthetic and practical insofar as its goal is to fashion a new 'posthuman entity' not in the form of a genetically or neuroprosthetically augmented human being but in the form of organizations that can survive and thrive within a rapidly evolving posthumanized ecosystem. Building on concepts from the field of organizational architecture, six particular aspects of organizations were identified that are likely to be impacted by ongoing posthumanization: namely, an organization's members, structures, information systems, processes, physical and virtual spaces, and external environment. Finally, we explored the manner in which technologies for human augmentation and enhancement, synthetic agency, and the construction of digital-physical ecosystems and networks are expected to increasingly drive the development of organizational posthumanity. It is our hope that this investigation of the ways in which a

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current and emerging posthumanity is transforming the shape, dynamics, and roles of organizations will both raise new questions and offer a path to developing creative insights that can inform the work of those who seek to understand the nature of organizations and those who are charged with managing them now and in the future.

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