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A Phenomenological Analysis of the Posthumanized Future Workplace

For a growing number of organizations, the adoption of emerging technologies for social robotics, advanced AI, virtual reality, neurocybernetics, and ubiquitous computing is resulting in an increasing “technological posthumanization” of such organizations’ business models and workforces. Here we employ approaches from phenomenological aesthetics to anticipate and analyze ways in which such forces of posthumanization can be expected to transform the architectural structure of the workplace, rendering many traditional anthropocentric assumptions about the workplace obsolete.

This analysis highlights opportunities that may become available and challenges that may arise for 21st-century organizations facing the realities of such change.

Technological posthumanization of the organizational workforce

The nature of posthumanization

The processes of posthumanization are those dynamics by which a society comes to include members other than natural biological human beings who, in one way or another, contribute to the structure, activity, and meaning of the society. Such forces typically result in a “de-anthropocentrization” of the society, as its membership is expanded to include other types of entities and the position of human beings is decentered; these forces chal-

lenge historical binaries of *human versus non-human*, *natural versus artificial*, and *biological versus mechanical* [Herbrechter, 2013; Gladden, 2016]. In the contemporary world, it is the dynamic of technological posthumanization that is particularly in urgent need of study.

Technological posthumanization of the organizational workforce

The dynamics of technological posthumanization are altering organizations so that they include an increasingly diverse spectrum of intelligent social actors – beyond just “natural” biological human beings – who collaboratively perceive and interpret reality, create knowledge and meaning, make decisions, and manipulate and transform the environment in order to advance an organization’s strategic objectives. For example, the roboticization of organizational agency means that a growing number of tasks previously handled by workers are now assigned to embodied artificial agents, creating a heterogeneous human-synthetic workforce [Ford, 2015]. Similarly, the growing use of mobile, wearable, or even implanted computers means that the physical person of a human worker becomes a locus for processes of real-time organizational communication and control. Such deepening human-computer integration incorporates human workers into an organization’s electronic

information systems in ways never before possible [Fleischmann, 2009; Gladden, 2016]. Developments in nanodevices, swarm robotics, ubiquitous computing, and the Internet of Things make it increasingly feasible for an organization to infuse the physical environment with large numbers of robotic agents that fill the space between their human collaborators and extend the organization’s reach of sensation, cognition, and action beyond the walls of its facilities and throughout the broader digital-physical ecosystem [Poslad, 2011; Evans, 2012]. Researchers are beginning to ponder the manner in which such emerging technologies may qualitatively transform future workplaces in ways far more radical than the changes wrought by the historical integration of assembly-line robots and desktop computers into the workplace or contemporary approaches to telecommuting and virtual offices [Eltringham, 2017].

Understanding the “workplace” as a multifaceted architectural structure

Here we focus on the posthumanization of the workplace understood as an architectural structure – often comprising a particular building (e.g., an office building, factory, school, hospital, library, theater, or freestanding retail store or restaurant) or particular portion of a building (e.g., an office suite, market stall, or retail outlet in an indoor shopping mall). The concept of a workplace as an architectural structure is a multifaceted one: drawing on contemporary definitions of architecture [Wasserman, et al., 2000], it includes not only the material, functional, and aesthetic aspects of the space in which work is performed but also the psychological, social, political, economic, technological, cultural, and ecological aspects of that structured space. The methodologies for designing such spaces may vary, depend-

Figure 1 Anticipated changes to the architecture of the future workplace resulting from technological posthumanization

| Anticipated impacts of technological posthumanization on the architecture of the future workplace | | | | |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Spatial density | Spatial scale | Filtering role of boundary | Orienting role of boundary |
| Historical anthropocentric assumptions regarding the architecture of workplace | The workplace is a largely empty space with significant extension in three spatial dimensions | The workplace exists at „human” scale, with elements easily perceptible and manipulable by human workers | The workplace's semipermeable boundary regulates the flow of information and other resources in and out of the workplace | The workplace possesses a trifold floor-wall-ceiling boundary that is compatible with the psychology and physiology of human workers |
| Potential changes to the architecture of the workplace resulting from technological post-humanization | A physical workplace may be a solid unit with no interior spaces; a virtual workplace may allow multiple workers to occupy the same space | The workplace may span a wide range of human and non-human scales; artificially intelligent systems may be able to bridge these divergent scales | Controlling the flow of resources in and out of the workplace may become impossible; boundaries between „home” and „work” may be wholly and purposefully dissolved | Orienting boundaries may be irrelevant for posthumanized workers; virtual workplaces may be experienced, e.g., as spherically environments without gravity |

Source: own elaboration.

ing on whether they are approached under the rubric of *workplace design* [Stewart, 2004], *office design* [Stegmeier, 2008], or *facilities design* [Heragu, 2016].

Analyzing the posthumanized workplace through a phenomenological lens

There are various ways of analyzing the future posthumanized workplace as an architectural structure. Here we employ approaches to the phenomenology of architecture developed in the field of philosophical aesthetics. We draw especially on the Heideggerian approach developed by Ch. Norberg-Schulz [1980] and the methodology of R. Ingarden that links classical realist phenomenology with modern systems theory [Ingarden, 1987]. Such analysis suggests numerous ways in which the forces of technological posthumanization can be expected to transform the architectural structure of the workplace. As illustrated in Figure 1, we focus on four such developments that have the potential to create significant opportunities and problems for future organizations' workplace design. For each item we describe a current anthropocentric facet of the workplace and the manner in which it is challenged by posthumanization.

The anthropocentric paradigm of the workplace as empty space

The workplace is never a point, line, or flat two-dimensional surface; the nature of the human body and mind require the human workplace to be a three-dimensional space possessing significant volume [Norberg-Schulz, 1980; Bush, 2011]. Historically, it has been presumed that a typical workplace building will include a certain number of floors or stories, each of which is somewhat taller than a typical human being. This vertical space is necessary for both psychological and physiological reasons: in those confined workplaces where the ceiling is lower

than the height of a human being (e.g., in certain types of tunnels or enclosed vehicles), a person's ability to see and move within the environment is reduced, and poor air circulation, fatigue, and feelings of discomfort and anxiety may impair a worker's effectiveness [Bush, 2011]. Similarly, a workplace generally possesses significant bidirectional extension in the horizontal plane [Miller, 2014; Norberg-Schulz, 1980]. Although it is sometimes appropriate to structure a workplace as a narrow, elongated structure (e.g., as in the case of a train platform or assembly line), this increases the average distance that employees must traverse to move between various points in the workplace, thereby decreasing efficiency; a workplace that has a square or circular layout in the horizontal plane reduces the distance between its points, allowing more efficient physical movement of resources within the workplace [Heragu, 2016].

A consequence of this human need for three-dimensional extension is the fact that the typical workplace comprises a building whose interior consists overwhelmingly, in any given moment, of *empty space* [Norberg-Schulz, 1980]. From a structural perspective, even when "in use", places like offices, hallways, auditoriums, warehouses, and garages are primarily voids. As a whole, human workplaces are thus highly "inefficient," architecturally: if somehow all of the empty space could be eliminated from an office building or factory without reducing the quantity or quality of the work performed within it, the building could be "distilled" or "compressed" to a much smaller volume; the ability to construct workplaces in the form of highly dense, nearly solid "blocks" rather than expanded, hollow "shells" could dramatically reduce the quantity of land, construction time, and materials needed for the creation of a building. In the case of an organization with a human workforce, such workplace

design is impossible; but it may become feasible in the case of a posthumanized workforce.

Impacts of the posthumanization of architectural space

A building occupied by a robotic workforce, for example, could effectively be built as a solid cube with no large interior spaces. Vertical division of a building into discrete human-heighted “stories” (or discrete units of any sort) would become unnecessary. While some manufacturing workplaces would still require passages for the admission of raw materials and emission of finished products, it is not necessarily even required to incorporate maintenance tunnels to provide human repair personnel with periodic access to robots located in a structure’s interior. Any needed diagnostic, maintenance, or repair work might be performed by the primary workforce robots themselves (who may all be capable of diagnosing and repairing neighboring robots) or by specialized microrobots or nanorobotic swarms that are capable of travelling through the negligible interstices that exist between workforce robots [Xi, Li, 2011; Gauthier, et al., 2014].

Indeed, there may not even be any need for prior construction of a separate building to house a robotic workforce; such robotic units may be fashioned with a modular, stackable design that allows them to attach firmly to one another to create a stable functional structure that is both building, equipment, and workforce at the same time and that can dynamically reconfigure its arrangement as required for operational purposes [Murata, Kurokawa, 2007] without any need for a separate architectural structure to support the robots. In this way, the distinction between a smart building (i.e., an architectural structure that has been “roboticized”) and structural robots (i.e.,

robotic workers that have been “architecturalized”) becomes blurred.

A posthumanized virtual workplace can also easily dispense with traditional architectural design in which empty space plays a predominant role. A human worker immersed in a virtual environment need not be provided with a three-dimensional (virtual) body of humanoid form [Won, et al., 2015]; by supplying users with the appropriate stream of sense data through the VR system, they can be provided with virtual bodies that resemble, e.g., points of light that can operate in close proximity to one another (or which can even be made to simultaneously occupy the same coordinates in virtual space) – thereby strengthening a virtual building’s capacity for gathering and centralizing [Norberg-Schulz, 1980]. Moreover, users need not “walk” through a virtual environment in a human-like manner; a VR system may simply provide them with the experience of “teleporting” from one location to another, eliminating the need for hallways and other passages [Jerald, 2015].

The presumption of the anthropocentric scale of the workplace

Equally important as the shape of a workplace building is the scale at which it is built. Not all structures present in the environment are relevant (or even noticeable) for human beings. Our nature isolates us sensorily, emotionally, and intellectually from those facets of reality whose scale falls outside of a certain narrow range [Ingarden, 1987]. From a phenomenological perspective, the only significant structures are those existing at “a medium or ‘human’ scale”; structures that are too large or small relative to human beings cannot be perceived, meaningfully interpreted, or productively manipulated [Norberg-Schulz, 1980]. A hypothetical building whose rooms and hallways were each several kilometers wide would thus be impossible for a human occupant to

conceptualize or experience as a building, as would be a “building” whose rooms and hallways were only millimeters wide.

Impacts of the posthumanization of architectural scale

This scalar aspect becomes significant in new ways for the posthumanized workplace, because the limited range of architectural scales that are possible and relevant for human workers may or may not coincide with those that are relevant for robots or AIs. It is not clear that a workplace whose structure and scale have been chosen to optimize the productivity, efficiency, security, and wellbeing of human employees will necessarily be simultaneously optimized to facilitate the work of systems like miniaturized robotic swarms whose field of perception and action is in the range of millimeters or micrometers [Xi, Li, 2011; Gauthier, et al., 2014]. The question thus arises whether it is desirable or even possible to create a single “workplace” shared among such human and non-human collaborators.

On the other hand, it is not clear whether the concept of architectural scale even has any meaning, e.g., for a dimensionless software routine controlling the behavior of an artificially intelligent organizational information system; such an element of a posthumanized workplace might be able to adapt readily to any architectural scale or to serve as a functional “bridge” between human and non-human workers with widely divergent scales.

The role of the workplace boundary as barrier and filter

Drawing on Heidegger, Norberg-Schulz [1980] suggests that the fundamental property of an artificially constructed place is that of concentration and enclosure. Such a structure is created by “gathering” certain entities (in the case of an organization, its human workers, information systems, manufacturing equip-

ment, raw materials, and other resources) and surrounding them with a semipermeable boundary possessing particular openings that allow the transmission of selected objects between the “interior” and “exterior” domains defined by the boundary. The presence of such a boundary allows a building to maintain its identity and exist as something distinct from its surrounding environment [Norberg-Schulz, 1980; Ingarden, 1987], while the particular nature of a boundary and its degree of openness give an enclosed space its unique character [Norberg-Schulz, 1980; Ingarden, 1987].

In the case of a workplace, one might say that its boundary serves a purpose of sheltering the workforce and partially isolating it from the dynamics of the external world, so that it can more readily focus its attention on its tasks and function without distraction or interference [Ingarden, 1987], while the openings in the boundary allow (1) a continual incoming flow of needed resources (like information) into the workplace and (2) an outgoing flow of finished products delivered into the external ecosystem, where they can be exchanged (e.g., with consumers) for more resources.

Impacts of the posthumanization of architectural filters

It becomes increasingly challenging for a posthumanized workplace to perform such a selective filtering function. Already – due to rapidly developing information and communications technology (ICT) relating to mobile computing and social media – the boundaries separating the inside of the workplace from its outside are being circumvented or dissolved. Employees in many industries are able to remotely connect to organizational information systems and perform work on a computer at home or on a laptop, tablet, or smartphone while commuting to and from work on the bus or train – in ef-

fect, creating a spatially disjunct “exclave” of the workplace that exists outside the boundaries of an organization’s physical facility [Nicklin, et al., 2016]. Not only the spatial boundaries of the workplace are being subverted but its temporal boundaries, as well: the previously clear distinction between the time when an employee is “at work” – the portion of the day that falls “within working hours” – and the time when an employee is “away from work” is becoming increasingly blurred or illusory. In many professions, workers are expected to be accessible for work-related inquiries or assignments even when at home in the evening or on weekends [Shih, 2004]. Simultaneously, the private lives of workers – their personal time and space – are increasingly seeping into the architectural structure of the workplace to fill its psychological and social space, as workers’ engagement with personal email, messaging, phone calls, social media, web browsing, and other forms of “cyberloafing” in the workplace grows [Blanchard, Henle, 2008].

Ongoing posthumanization of the workplace might serve either to accelerate or counteract such weakening of its spatiotemporal boundaries. For example, the increasing presence of ubiquitous networked sensors and sophisticated AI within the workplace may be used by organizations in proactive attempts to automatically detect, discourage, or block the “colonization” of the workspace by pockets of employees’ personal space. Already a number of large organizations are deploying controversial workplace monitoring systems of this sort. However, by regulating the boundary openings that permit the flow of information in and out of the workplace in an aggressive way, such efforts run the risk of counterproductively transforming the character of the workplace into one that is oppressive, stifles valuable social interaction and cre-

ativity, diminishes employee loyalty, and is even experienced by workers as dystopian in nature [Chory, et al., 2015; Glad-den, 2015].

On the other hand, an organization might choose to deepen the integration of its information systems with employees’ personal mobile ICT devices and the smart-home AI that “animates” their own personal residences to create an environment in which employees are always “at work” and always “at home” – with workers allowed (and even encouraged) to move seamlessly between various social, functional, and economic spaces in instants of their own choosing, regardless of which architectural space they may be physically occupying at a given moment [Quoquab, et al., 2015].

The trifold nature of the workplace boundary as *floor-wall-ceiling*

Historically, the architecture of a workplace does not display a single undifferentiated boundary but a set of connected boundaries: while different types of architected workplaces possess different types of boundaries, they all manifest the fundamental trifold structure of floor-wall-ceiling, which in turn reflects the inherent ground-horizon-sky boundaries of the natural environment [Norberg-Schulz, 1980]. A warehouse or open-plan office building comprising a single large space creates a single such “world” within itself, while a multi-story office building includes many such recreations of the natural environment, stacked one atop the other.

The spontaneous differentiation of the boundaries of floor/ground, wall/horizon, and ceiling/sky is rooted in the nature of the human body and mind. A simple protozoan that spends its life suspended in the depths of the ocean experiences its environment as having only a single boundary: uniform pressure and dark-

ness extend in all directions. If spherically symmetrical, such an organism has no top or bottom, no front or back. Its orientation is irrelevant, as it spins randomly in the current [Holló, 2017]. A human being, however, is quite different. Our visual system allows us to sense environmental structures that lie at some distance; we are able to mentally discover (or construct) varied boundaries that exist far outside of our bodies. Our vestibular system allows us to detect the direction of gravity, and our upright posture means that we instinctively orient our body in the environment according to concepts of up and down, with reference to the boundaries of the ground that we are always touching and the sky that we can never reach. Moreover, our lateral symmetry means that we organize space according to that which is “in front of” and that which is “behind” us; the horizon is the furthest point in front of us, the boundary beyond which we cannot see [Tuan, 1977; Norberg-Schulz, 1980].

Impacts of the posthumanization of architectural orientation

In a posthumanized future workplace, the trifold boundary of floor-wall-ceiling may become less important and even less possible to maintain. While some computerized equipment relies for its proper functioning on the force of gravity and a particular spatial orientation, a solid-state computer may have no means of detecting whether it is “right side up” or “upside down,” and such distinctions make no difference to its behavior. An artificially intelligent worker may thus be capable of operating flawlessly without regard to the (potentially variable) orientation of the workplace relative to itself [Pai, et al., 1994]. Similarly, swarm nanorobots may be designed to operate on randomly oriented surfaces or in liquid media in which their precise spatial orientation is unpredictable [Xi, Li, 2011; Gauthier, et

al., 2014]. Moreover, while virtual reality can never eliminate a human user’s sense of up and down (since that depends on elements of the inner ear and the layout of the eyes, which are part of the user’s physical biological body and not his or her virtual body) [Jerald, 2015], VR environments may minimize the relevance of spatial orientation and the trifold boundary by (1) providing a human visitor with a virtual body displaying aspects of spherical symmetry, allowing him or her to “float” weightlessly in virtual space and rotate freely in all directions and (2) creating architectural structures that are roughly spherically symmetrical (e.g., in the form of a central icosahedron with passages opening in all its faces) rather than displaying fixed and distinct horizontal and vertical “dimensionality”.

Management implications of the posthumanized workplace

While much research is being done into the societal impact of robotics and AI at a macroeconomic level, relatively little attention has been paid to the potential impacts of technological posthumanization on the management of individual organizations. Here we would point out two such impacts worthy of further study that relate to architectural dynamics of the sort described above. First, the question of whether to build or lease organizational facilities acquires new dimensions: given the rapid pace of posthumanizing technological change, it is unclear whether, e.g., a new corporate headquarters designed today to house hundreds or thousands of human workers will still be desirable – or even usable – ten or fifteen years from now. Leasing facilities may enhance an organization’s ability to adapt to ongoing technological change; it can be especially attractive in cases where construction of a new facility is only financially viable if an organization will continue to use it for several decades.

Second, as Saudi Arabia becomes the first country to grant “citizenship” to a robot and political bodies like the European Parliament consider whether to grant robots some form of legal rights as persons [Stone, 2017; Murphy, 2018], new issues arise regarding the siting of organizational facilities that integrate AI and robotics into their architecture. An AI-controlled smart factory located in one country may be recognized as a legal entity possessing its own rights, while an identical building located in another country would not. Such issues are further complicated, e.g., when a robotic facility located in one country is remotely controlled by AI running on servers in other countries. In the case of an immersive virtual workplace uniting human and artificial workers from around the globe, it may not be clear which country’s laws (if any) apply, e.g., to cases of malpractice, fraud, or employment discrimination occurring within that virtual setting. The technological and architectural questions regarding the placement and design of posthumanized

organizational facilities thus increasingly become entangled with novel legal issues and ongoing public policy debates.

Conclusion

As discussed above, it is anticipated that the ongoing technological posthumanization of organizations will qualitatively transform the architectural structure of the future workplace by upending historical anthropocentric paradigms of the workplace as a largely empty space that exists at human scale, possesses a trifold floor-wall-ceiling boundary, and serves as an effective spatiotemporal filter. The four phenomena described in this text are by no means the only ways in which the forces of posthumanization might be expected to reshape the 21st-century workplace. Nonetheless, it is hoped that the analysis formulated here can serve to illustrate the potential impacts of posthumanization on workplace architecture and help organizations to prepare for the challenges and opportunities that lie ahead.

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