BOHS
British Occupational Hygiene Society

The Chartered Society for Worker Health Protection

OXFORD

Psychosocial risks and ethical implications of technology: considerations for decent work

Paul A. Schulte[1,] [iD] and Jessica M.K. Streit[2,*,] [iD]

[1]Advanced Technologies and Laboratories International, Inc., Gaithersburg, MD, 20878, United States
[2]Office of Research Integration, Office of the Director, US National Institute for Occupational Safety and Health, Cincinnati, OH, 45226, United States
*Corresponding author. Email: jstreit@cdc.gov

Abstract

Decent work, a United Nations Sustainable Development Goal, is built on the ethical treatment of workers and ensures respect of their security, freedom, equity, and dignity. In the future, a wide range of technological forces may pose significant impediments to the availability and quality of decent work. This paper applies a prescriptive taxonomy to categorize evidence of the psychosocial impacts technology may bring to the future of work and elucidate the associated ethical concerns. Ethical objectives in support of a future defined by decent work are also offered. Central to this technoethical discourse are the principles of nonmaleficence, beneficence, autonomy, justice, and respect for persons. Expanded technoethical education, ethical technology assessments, ethical foresight analysis, and revised ethical standards are important ways to address technology-related ethical challenges on a larger scale. The findings in this paper may serve as a foundation for the systemic prevention and control of adverse effects and ethical concerns from the use of technology in the workplace of the future.

Keywords: automation; autonomy; digitization; future of work; justice; nonmaleficence; respect for persons

---

What's Important About This Paper?

Technology continues to transform the day-to-day lives of workers around the world. This study presents a taxonomy of psychosocial risks and ethical objectives for decent work in the context of technology in work. Multiple strategies are necessary to systematically prevent and control adverse effects and ethical concerns related to the use of technology in the workplace of the future.

Introduction

The "future of work" has become a topic of great importance for the research, industry, and labor communities alike. Though lacking a universal definition, it is generally accepted that the future of work refers to change over time with respect to (i) *work*, or what and how tasks are performed; (ii) the *workplace*, or where tasks are performed; and (iii) the *workforce*, or who performs tasks (Tamers et al. 2020; Lim 2023; McKinsey and Company 2023). In addition, discussions of the future of work are frequently built around

technology as a key driver of change for the performance and health of both organizations and individuals (Singh et al. 2022).

For decades, the opportunity to engage in decent work has been globally recognized as a central component of a sustainable future (International Labour Organization (ILO) 1999; United Nations 2015, n.d.). Today, decent work is defined as a system in which all people live autonomously, contribute to society through safe and secure employment, and receive fair wages and opportunities for growth and advancement (Braganza

---

et al. 2021; International Labour Organization (ILO) (n.d.)) Accordingly, decent work is often recognized as a fundamental human right (United Nations 1948; International Labour Organization (ILO) 2013). Four conditions have been noted as essential to experiencing decent work: *security* and safety for people and communities; *freedom* from the compulsion of others; *equitable* and impartial treatment of all people; and *human dignity*, or recognition of the intrinsic value of all human life (Rantanen et al. 2020; International Labour Organization (ILO) 2022).

Though there is broad international support for the concept, concerns exist around the practicality of decent work ideals. Opportunities to provide decent work are influenced by a number of contextual factors, which can result in tensions between privileged economic interests and access to good working conditions (Di Ruggerio et al. 2015). One of these factors is rapid technological advancement, which is often cited as a critical driver of future change (D'Cruz et al. 2022). Advanced, advancing, and emerging work-related technology shows promise and value in contributing to the completion of job tasks (Schmid and Dowling 2020). Examples include automation, artificial intelligence (AI), the Internet of Things, robotics, 3D printing, advanced manufacturing, and blockchain (European Commission n.d.).

Applying an ethical (ie moral) code to the use of technology—known as technoethical standards—can help guide the safe and effective design and application of technology for work settings (Longo et al. 2020; Cebulla et al. 2023). Failure to consider and uphold technoethical standards, however, can hinder decent work conditions by leaving workers vulnerable to poor safety and health outcomes or reduced well-being (Yamamoto 2019; Kellogg et al. 2020; Schulte et al. 2020; Bailey 2022; Howard 2022; Kendal 2022; Fisher

et al. 2023; Jetha et al. 2023a). This complex relationship between technology, ethical considerations, and the achievement of decent work is depicted in Fig. 1.

Accordingly, intense concern has arisen about the impact of technology on the future of work (Healy et al. 2017; Disselkamp 2020; Lindholm et al. 2020; Schulte et al. 2020; Anderson and Rainie 2023). While the broad technoethical literature is rich (Ihde 1991; Moor 2005; Dusek 2006; Swierstra and Rip 2007; Brey 2012; Capasso 2023; Dhirani et al. 2023; España et al. 2023), there is a dearth of discussions on technoethical concerns specific to workers. Consequently, the human–technology relationship has been identified as a central topic for ethical discussions on the future of work, particularly the future of decent work (Disselkamp 2020). In response, this paper seeks to advance future of work discourse by: (i) organizing information about the psychosocial risks and hazards associated with technology use in the future of work and (ii) elucidating ethical concerns raised by technology use and its implications for the future availability of decent work.

Methodological approach

Facilitating the intended exploration of the future of decent work required three elements: (i) a structured organizing framework for technology; (ii) a set of key ethical principles underlying the premise of decent work; and (iii) information describing possible roles of technology in the future of work. This section details how these elements were selected and combined in pursuit of the paper's aim.

Selecting a technological framework

Applying a prescriptive taxonomy was important to help organize the exploration of technology, its associated psychosocial risks, and the potential ethical
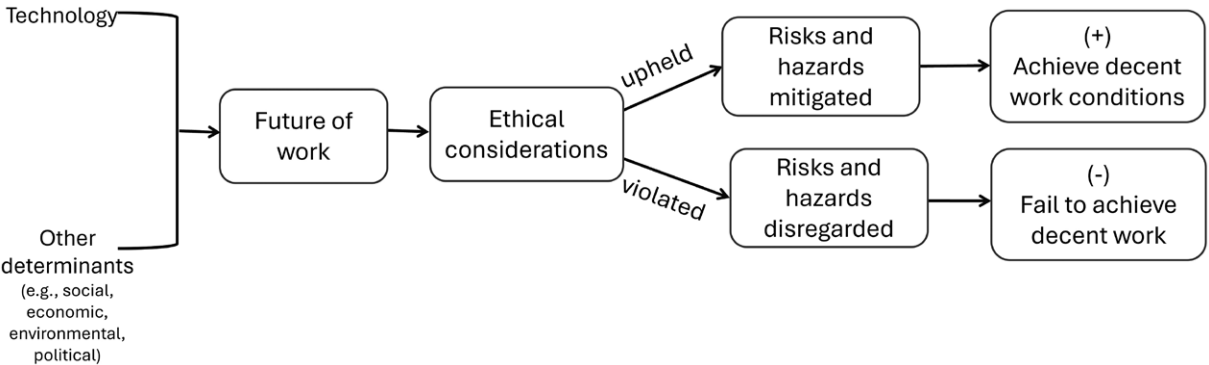
Fig. 1. Conceptual view of the relationship between technology, the future of work, ethics, and the achievement of decent work. When ethical considerations are upheld in the design and use of work technology, conditions conducive to decent work can be achieved. When ethical considerations are violated, decent work cannot be achieved.

concerns for the future of decent work. Given the scarcity of worker-specific technoethical research, there was no prevailing paradigm or framework for this endeavor. However, a search located a taxonomy that classifies technology applications in the future of work into four categories: automation, brokerage, management, and digitization (Dellot et al. 2019). Table 1 provides a brief explanation of each taxonomic category.

In the initial application of the four-part taxomony, Dellot et al. (2019) proposed solutions to proactively address many technology-related issues before they fully come to bear. This included the development and stewardship of ethical technology for work. Thus, given the future-oriented focus and ethical foundation of the taxonomy, it was selected as the framework to organize the current discourse around technoethics and the future of decent work.

Identifying ethical principles linked to technology and decent work

Despite some noted limitations (Mitteldstadt et al. 2016), many technology-related ethical initiatives and discussions build upon the fundamental principlist code of nonmaleficence, beneficence, justice, and respect for persons (Schulte and Salamanca-Buentello 2007; Floridi et al. 2018; Yilma 2024). For example, Schulte and Salamanca-Buentello (2007) articulated two critical work-related scenarios that are directly relevant to the application of advanced technology in the workplace—workers' acceptance of risks and the selection and implementation of workplace controls—and outlined five distinct but interrelated ethical principles associated with these scenarios:

- *Nonmaleficence:* the obligation to cause no harm—namely, to cause no pain or suffering, to not incapacitate, to not intentionally offend, and to not kill (Varkey 2021).
- *Beneficence:* acting in the best interests of and promoting the welfare of others (Cheraghi et al. 2023).

- *Autonomy:* individual freedom of choice and informed decision-making based on personal values, goals, and self-reflection (Friedman 2006).
- *Justice*: fair and equitable treatment of persons and distribution of burdens and benefits (Nukaga 2019).
- *Respect for persons*: recognizing the worth and dignity of all people as a basic human right (Subramani and Biller-Andorno 2022).

Four of these principles (nonmaleficence, beneficence, justice, and respect for persons) stem directly from pure principlism (Beauchamp and Childress 2019), whereas the fifth (autonomy) is a longstanding ethical topic of great importance in technology-related discussions (Calvo et al. 2020).

Together, these five principles can be mapped to help explain the primary ethical concepts undergirding the four conditions for decent work (ie security, freedom, equity, and dignity) (Rantanen et al. 2020), as shown in Table 2. While this table highlights *primary* ethics-to-decent work condition linkages, it is important to note there are additional undeniable relationships between the ethical principles and conditions for decent work. For example, in addition to security, nonmaleficence and beneficence also relate to freedom, equity, and dignity at work. Similarly, respect for persons is fundamental not only to human dignity, but also to freedom, equity, and security. Because of this extensive alignment with the decent work conditions, these five principles were selected as the focus of ethical discourse in this paper.

Describing the role of technology in the future of work

In 2020, Schulte et al. conducted a comprehensive and systematic literature review for the period 1999–2019 to identify future of work scenarios and the hazards they imply for workers (Schulte et al. 2020). Perhaps not surprisingly, technology was identified as a primary driver of change in most scenarios, and psychosocial hazards were the most pervasive adverse outcomes anticipated for future workers (Schulte et al. 2020).

Table 1. Description of the four taxonomic categories of technology (Dellot et al. 2019).

Category	Definition
Automation	Technology takes the place of human labor or enhances human capacity
Brokerage	Technology functions as a mediating platform that connects buyers (eg employers or customers) to sellers (eg workers)
Management	Technology is used to manage, monitor, or control workers
Digitization	Technology converts physical goods information into data that is efficiently replicable, shareable, and transferable

Table 2. Ethical principles conceptually mapped to the conditions for decent work

Underlying key ethical principle(s)	Decent work condition	Rationale for linkage
Nonmaleficence and beneficence	Security	• Nonmaleficence (doing no harm) and beneficence (maximizing benefits while minimizing harms) support the creation of secure and safe working conditions • Nonmaleficence and beneficence are noted ethical principles driving employer and organizational actions to promote worker safety and security (NIOSH 2023)
Autonomy	Freedom	• Autonomy (freedom of choice and informed decision-making) is essential in an environment where individuals are free from the compulsion of others • Autonomy has long been associated with the concepts of personal freedom, choice, control, and decision-making (Azais 2011; Rosenfield 2011)
Justice	Equity	• Justice (fair treatment of people and distribution of burdens and benefits) is the foundation of equity • Previous research demonstrates that "equity is concerned with the just distribution of resources in society" (Lewis et al. 2021)
Respect for persons	Human dignity	• Respect for persons (recognizing the worth of all people as a basic human right) is the cornerstone of human dignity • Published ethical commentaries identify respect for all human life as a precondition for building a system that upholds human dignity (Autiero 2020; Jafari et al. 2024)

The technology-focused scenarios from Schulte et al. (2020) served as the foundational content for the current technoethical exploration. These scenarios were supplemented with contemporary scenarios, critical commentaries, reviews, and scientific studies to ensure robust representation of Dellot et al.'s (2019) taxonomic technology categories—automation, brokerage, management, and digitization—and their implications for the future of work.

Combining the elements to achieve the aims

Achieving the paper's primary aims required a two-step process. First, the selected technological framework was applied to the selected literature to organize the exploration of risks and hazards associated with technology use in the future of work. The ethical principles undergirding the conditions required for decent work were then examined in the context of those risks and hazards. The results of these steps are detailed in the following section.

Key findings

Psychosocial risks associated with technology in the future of work

This section provides an overview of the psychosocial risks associated with the four taxonomic technology categories from Dellot et al.'s (2019) framework. The information presented here is not meant to be an exhaustive review of the literature. Rather, it is meant to provide the necessary foundation for the subsequent commentary on the ethical concerns and challenges these types of technology raise for the future of decent work. Table 3 summarizes the key points of this section.

Automation

Automation uses technology to minimize the human inputs required to perform certain tasks (Schmitz et al. 2009; Eurofound 2018). At least four unique forms of technological automation have been identified in scenarios for the future of work: (i) *substitution*, whereby technology performs work previously done by humans; (ii) *augmentation*, where technology expands workers' physical or cognitive capacities; (iii) *generation*, in which technology undertakes tasks previously done by very few, if any, humans; and (iv) *transference*, which eliminates workers by shifting tasks to a nonworker (eg self-service stations and kiosks for customers) (Daily et al. 2017; Johansson et al. 2017; Dellot 2018; Taylor 2018). Automated technologies like AI and machine learning (ML) have the potential to affect the amount, type, and distribution of work (Manyika et al. 2017). While these technologies may have many positives, they may also pose a number of risks, including widening inequality gaps, enhancing perceptions of differential treatment, creating unsafe physical and psychological conditions, and blurring the boundary between work and home (Fisher et al. 2023). In addition, evidence-based scenarios for the future suggest that automation and AI will bring about profound changes in work as job tasks are automated (Eurofound 2018; D'Cruz et al. 2022). While these changes will potentially reduce dull or dangerously repetitive work, they may also challenge workers' ability to remaining competitive in the labor market (Ghislieri

Table 3. Psychosocial risks associated with technology

Category	Associated psychosocial risks
Automation	Accidents and diseases related to human–machine interaction • Overload and overwork from continuous information availability • Job precarity due to the automation of structured, routine tasks • Transformation of job skills needed to remain competitive • Lower job control • Increased threat of job loss • Greater physical and psychological work demands • Burnout
Brokerage	• Nonstandard work hours • Disrupted social lives • Unhealthy sleeping patterns • Intensified work environments (working faster, taking more risks) • Increased feelings of undervaluation • Reduced compensation • Fewer benefits and protections • Lower job control • Differential treatment • Increased potential for work-related violence and harassment
Management	• Low autonomy and job control • Reduced decision-making authority • Decreased privacy • Bias • Longer working hours • Irregular work schedules • Work–life imbalances
Digitization	• Job loss • Work–life issues • Occupational inequities for vulnerable groups • Work precarity • On-demand service models • Societal polarization • Strain, stress, and anxiety • Mental overload • Exhaustion and burnout • Addiction • Job dissatisfaction • Turnover • Decreased well-being

et al. 2018; Pham et al. 2018). Workers engaged in tasks with a high probability of automation may experience significantly lower levels of job control along with higher levels of job insecurity and occupational injury and illness (Cheng et al. 2021). On the other hand, workers in jobs classified as having a low probability for automation may experience greater physical and psychological work demands, potentially leading to burnout (Cheng et al. 2021).

Brokerage

Brokerage describes the role of technology as a platform to facilitate the relationship between buyers (eg employers and individual customers) and sellers of goods and services (eg gig workers) (Dellot et al. 2019).

Though brokerage facilitated through mobile applications has been touted as providing workers greater scheduling flexibility (Dunn et al. 2023), these work arrangements also come with many downsides for gig workers. The use of various technologies, such as AI, can result in fundamental asymmetries between workers and platform owners, leading to increased stress, economic instability, and reduced job control (Campolo et al. 2017). Because these platforms support the notion of an always-open economy, gig workers often make their living during nonstandard hours (Moore 2019). This situation can lead to increased fatigue, subpar sleep, and social life disruptions, which can have deleterious effects on workers' health and well-being (Crain et al. 2020; Glavin et al. 2021). Moreover, when employment

is brokered through technology, workers frequently receive fewer benefits, less protection, and reduced income (Dubal 2022). The piece-rate and customer-ranking evaluation systems of gig work can also lead to intensified environments that incentivize working faster and taking more risks (Moore 2019). Brokerage may also exacerbate sex-based disparities, as higher percentages of females than males engage in platform work from home during evening and night hours (Moore 2019).

Management

Technology can be used to manage and control workers' tasks, including worker monitoring and surveillance (Dellot et al. 2019). For knowledge-based workers, such management may include tracking availability, computer movement, and email use (EU-OSHA et al. 2018; Ball 2021). In other occupations, wearable sensors can detect workers' bodily movements and vibrations, task completion, fatigue levels, mental acuity, stress levels, mood, emotions, safety compliance, and rest breaks (Patel et al. 2022). Management technology can also leverage algorithms for routine scheduling and employee recruitment (Parente et al. 2020; Fu et al. 2021; Chen 2023a; Lucas et al. 2023).

Although management-by-technology can increase efficiency, revenue, and innovation (Kellogg et al. 2020), it can also increase psychosocial risks for workers. In particular, management algorithms that allocate work, monitor and direct, or discipline and reward workers may be built using biased data, which can exacerbate occupational inequities and differential treatment (High Level Expert Group (HLEG) 2019; Todoli-Signes 2021; Chen 2023b). Regular managerial monitoring may diminish workers' autonomy, decision-making capacity, and privacy. Moreover, constant communication and availability via smartphones and email can lead to longer working hours and enhanced blurring of work–life boundaries (Johansson et al. 2017; Caruso 2018; EU-OSHA et al. 2018; Chia et al. 2019).

Digitization

Digitization uses technology to turn physical goods and knowledge into data that can be easily replicated, shared, and stored (Dellot et al. 2019). Today, digitization is leading to significant changes across the work paradigm due to emerged and emerging technology, such as automation, AI, cloud computing, ML, blockchain, and robotics (Bresciani et al. 2021). While digitization has brought many societal benefits, it has also created many challenges for the labor force. It has been linked to pervasive "technological ill-being" for workers, which includes adverse outcomes such as strain, stress, anxiety, mental overload, burnout, exhaustion, addiction, job dissatisfaction and turnover, and work–family issues (Marsh et al.

2022). Digitization has also contributed to fears of job loss, particularly for vulnerable groups that perform routine, repetitive job tasks (Campa 2019; Chia et al. 2019; Daheim and Wintermann 2019; Grimshaw 2020). Over time, digitization is anticipated to contribute to increases in work precariousness (ie poorly paid, unprotected, insecure work), platformization (ie on-demand work), and societal polarization (ie erosion of the middle class) (Johansson et al. 2017; Balliester and Elsheikhia 2018; Latos et al. 2018; Meda 2019).

Identifying and addressing ethical concerns of technology use in the future of work

The psychosocial risks noted in the previous section, which are associated with automation, brokerage, management, and digitization, raise a number of ethical concerns that challenge the concept of decent work. It is important to note these ethical concerns do not manifest from technology itself but rather from the way it is applied and used (Ogar et al. 2018). As emergent forms of technology are implemented, they may also converge and interact. Convergence, or linkages and synergies between technological developments, can occur by happenstance, by concerted action, or as the byproduct of creativity (Roco and Bainbridge 2002; Nordmann 2004).

Below, a discussion of ethical concerns related to independent and convergent technologies is organized around the guiding principles of nonmaleficence, beneficence, autonomy, justice, and respect for persons, which underlie the decent work conditions of security, freedom, equity, and human dignity. Aspirational action-oriented objectives designed to support a future that provides access to decent work are noted throughout the discussion and summarized in Table 4.

While this discussion focuses on ethical practices that promote decent work and protect workers from technological hazards, it is understood that firms and employers have other objectives, functions, and accountabilities to stockholders and profitability that cannot be ignored. There may not always be alignment or harmony between these areas of responsibility and the promotion of decent working conditions. What employers "owe" society and who "owns" the responsibility to coordinate resolution of the concerns and challenges remain open for discussion.

Identifying and addressing nonmaleficence and beneficence concerns

The ethical concepts of safety and harm have become immensely complicated by advancements in technology and data accessibility (Heikkerö 2006). Questions exist around the potential ethical and social harms associated with pervasive computing (as information and communication technology is everywhere

Table 4. Ethical considerations of technology use in the future of decent work

Underlying key ethical principle(s)	Decent work condition	Aspirational ethical objectives to support decent work
Nonmaleficence and beneficence	Security	• Design and use new technology or data sources without harm to workers • Integrate extensive testing of the physical and psychological effects of technology into its design • Continuously monitor the health and well-being effects of technology in the workplace • Willingly forego the use of new technology if the adverse effects for workers are too severe • Consider workers as active consumers of work-related technology • Broaden labor regulations to provide enhanced social protections, job-search support, and additional interventions that increase workers' sense of personal agency
Autonomy	Freedom	• Prioritize human-centered design • Embed social and behavioral theories in technology development and evaluation • Pursue participative approaches that involve employers, management, and workers • Respect workers' freedom of choice, particularly with respect to augmentation
Justice	Equity	• Proactively recruit workers disproportionately affected by technology to upskilling and re-skilling opportunities • Build workers' sense of psychological ownership • Foster clear and open two-way communication about technology • Enable direct employee participation in decision-making related to technology • Solicit ongoing employee feedback • Provide training and development opportunities related to new technology
Respect for persons	Human dignity	• Engage in human-centered digitalization strategies • Protect workers' privacy • Enhance data security measures • Facilitate natural human–robot interaction

for everyone at all times), including effects on privacy, information overload, and freedom of choice (Herkert 2010). Physical and cognitive technological enhancements of workers also raise new questions about what constitutes harm to workers. In addition, workers' interaction with humanoid robots that look and appear to "think" and act like humans poses a number of dilemmas related to social morality, connectedness, humanity, obligations, and norms (Herkert 2010; Danaher 2019; Friedman 2023).

Breaches of employer–employee contracts—whether real or perceived—can also be characterized as violating nonmaleficence and beneficence. Technology has changed the landscape of employment contracts, leaving workers vulnerable to violations that lessen job security (Faraj and Pachidi 2020). Breaches may occur to written legal employment contracts or to the psychological and social contracts between workers and their employers (Rousseau 1995).

Upholding the principles of nonmaleficence and beneficence places an ethical burden on employers, trade associations, designers, insurers, and authorities to do no harm and to act in the best interests of workers when implementing new technology or utilizing big data. Meeting obligations of nonmaleficence and beneficence with respect to the design and implementation of new work-related technology is complicated. Indeed, decision-makers may be unaware that preemptive

technological improvement is even needed. When the need for change is finally realized, the adverse effects may be too great or the corrective process too complicated, costly, and/or prohibitive (Collingridge 1980; Capasso 2023).

Supporting work security to ensure access to decent and meaningful work will likely require shifts in long-held attitudes and values of some technology interest groups, such as policymakers, other decision-makers and authorities, technology designers, and employers (Braganza et al. 2021). One of these values shifts might include prioritizing workers' health, safety, and well-being over what is expedient or profitable. Putting this shift into action could entail extensive pretesting of technology for risks, continual monitoring after deployment, and the inherent willingness to forego use if the risks to workers become too severe over time (van de Poel 2016; Hosseini et al. 2023). This shift may also include respecting workers' right to disconnect from work during nonwork hours and holidays, a concept that has already been legislated in some European countries (Hopkins 2024). At the same time, there has been a call for policymakers to broaden labor regulations to provide enhanced social protections, job-search support, and personal agency as technology changes the employment landscape (Djankov and Saliola 2019).

At the organizational level, employers can uphold beneficence and nonmaleficence and support decent

working conditions by soliciting feedback on the technology needed to complement the skills workers bring to the organization (Stiles *et al.*, 2025). Such an arrangement should, theoretically, enable workers to provide feedback on technology as it is implemented, thereby improving their work experience and solidifying their feelings of psychological connection and security (Stiles *et al.*, 2025).

Identifying and addressing autonomy concerns

The use of advanced technology in the workplace has the potential to both increase and decrease human workers' freedom and autonomy. Tech-based platforms have fostered autonomy through leaderless teams and flat organizational structures; group-based brainstorming, problem-solving, and consensus-based decision-making; and transparent incentive systems (Bernstein et al. 2022). To a far greater extent, however, ethical concerns have been raised around the impact of new technology on workers' autonomy, including individual freedom of choice and decision-making capacity (Burr et al. 2019).

Indeed, advanced technology can negatively affect workers' autonomy in many ways. Technology use to monitor and micromanage employees can diminish autonomy, decision-making capacity, and privacy (Caruso 2018; High Level Expert Group (HLEG) 2019; Baiocco et al. 2022; De Stefano and Taes 2023). Power and control imbalances that diminish autonomy and worker agency can also result from the use of brokerage technology to facilitate gig work (Jarrahi 2019; Bucher et al. 2021; Newlands 2021). Algorithms applied to both gig and traditional employment reduce autonomy if workers cannot clearly understand how or why management systems are making certain decisions (Jarrahi 2019).

Considering human-centered algorithmic design approaches may help preserve workers' autonomy when utilizing technology for brokerage, management, and monitoring purposes. In particular, key stakeholders can draw upon social and behavioral theories to gain important insights into human users and their understanding of algorithmic systems (Baumer 2017). They can then explore initiatives that promote inclusive and participatory decision-making related to the purpose, design, and application of such technology to increase transparency and communication, enhance workers' feelings of control and personal agency, and identify innovative solutions to address challenges presented by these systems (Baumer 2017; le Feber et al. 2020; Inclusive Design Research Centre n.d.).

Overreliance on technological success may also lead to significant reductions in autonomy. Human memory, reasoning, decision-making, and other cognitive functions can decline when technology is relied on as a universal organizational solution. This can create circumstances where individuals' autonomy is degraded and they are left helpless should the technology fail (Torreson 2018).

Additional research is needed on how to promote human agency, enhance human functioning and control, and support positive well-being for workers who regularly interface with technology (Gibbs et al. 2021; Anderson and Rainie 2023). In practice, employers may begin by seeking expert implementation or communication guidance when selecting and deploying new technology in the workplace. This can help prevent against adverse technology design and use plans that deny individual freedom, erode workers' cognitive abilities, or leave workers without solutions in the face of technological failure.

Identifying and addressing justice concerns

Widespread technological change and the diffusion of technology suggest many workers will be increasingly unable to keep pace with the changes underway, particularly older workers, workers with disabilities, and low-skilled and low-wage workers (Dantas et al. 2019; Kendal 2022; Kolade and Owoseni 2022; Jetha et al. 2023b). Moreover, it is unlikely those workers who are displaced by technology will be the ones to get the new jobs technology may create due in large part to a skills mismatch (British Academy/Royal Society 2018; Neffke et al. 2023). Thus, the inequitable distribution of the adverse impacts of emerging technology on workers is incongruent with the ethical principle of justice.

Equity in a decent work future fairly distributes the costs, risks, and benefits of technology use for workers, including fair access to additional training and skills building (Ra et al. 2019; Morena et al. 2020). When a society values decent work, organizations proactively recruit workers disproportionately affected by technological advances into opportunities for training, including upskilling and reskilling. *Upskilling* focuses on building skills to become more effective in one's current role or occupation (Moore et al. 2020). *Reskilling* focuses on building new skills and competencies and transitioning to a new industry or occupation (Sawant et al. 2022).

Workers may further consider certain uses of technology to be unfair, unjust, or morally wrong, especially when they involve continuous performance monitoring or body tracking (Herbert and Tuminaro 2008; Constantinides and Quercia 2022). Algorithmic performance ratings of workers can also be subject to potential stereotyping (Fisher et al. 2023). Workers may have few, if any, mechanisms available to contest performance-rating approaches or outcomes they believe are unfair (Kellogg et al. 2020), which may in turn

increase these workers' willingness to engage in unethical behaviors of their own (Beunza 2019; Kellogg et al. 2020).

Building workers' sense of psychological ownership over the selection and implementation of technology may positively impact their perceptions of justice and fairness and increase positive and desirable behaviors at work (Jnaneswar and Ranjit 2022). Participative interventions aimed at building psychological ownership at the individual, team, and organizational level can enhance belongingness, self-efficacy, self-identity, and accountability while managing territoriality, all of which are beneficial to decent work (van Zyl et al. 2017). Designing and evaluating such solutions will require cooperation between employers and workers and collaboration among researchers, industry, labor, technology developers, and decision-makers (Mittelstadt et al. 2015).

Identifying and addressing respect for persons concerns

Respect for persons—perhaps the most fundamental of all the ethical principles—can be challenged by any technology. Examples include implementing automation with excessive profit over people in mind, commodifying workers for the sake of 24/7 convenience on brokerage platforms, and excluding workers from decision-making related to technology or potential controls to mitigate associated exposures or ill effects.

To ensure workers' dignity is maintained, companies should employ human-centered digitalization strategies. Implementing such strategies may require a full analysis of tasks, abilities, available resources, existing cultural norms, and relevant legal and regulatory authorities (Traumer et al. 2017; Krzywdzinski et al. 2022) to clarify what tasks are best suited for human workers, technology, or a combination of the two (Kreuzwieser et al. 2023). Such a conscientious analytic approach is well-positioned to advance decent work opportunities by integrating technology in ways that enhance human agency and dignity.

Additional questions also arise with respect to workers' rights when it comes to controlling their personal data. Key among these questions is what data on workers are collected, who can access data, and who owns data (Wilk 2019). As data collection and monitoring techniques continue to advance, a human-centered approach would consider what data are necessary and available to collect (just because an organization *can* collect specific data, does that mean it necessarily *should*?); assess the current cultural status (what are the prevailing organizational norms with respect to personal privacy and information sharing?); and review relevant laws, regulations, and standards associated with information governance and data se-

curity before implementing any new worker surveillance protocols.

Trust is another key feature of respect that can be challenged by technology use. The successful interaction of humans and machines—in particular, robots and AI-enabled systems—centers on the extent to which humans trust and respect the machines and, possibly at some point, whether the machines demonstrate respect and trust for humans. Harms to workers could arise if trust is misplaced or based on incorrect assumptions or if there is a lack of managerial insight into human–robot team dynamics and processes (Ulhoi and Norskov 2022).

Large language models, such as AI chatbots, are currently being explored as an intervention employers can leverage to improve communication and collaboration—and, consequently, trust—between people and machines by facilitating more natural human–robot interaction (Ye et al. 2023). Key components of trustworthy AI have been enumerated (Howard and Schulte 2024).

Aspirational considerations for advancing work-related technoethics

The principles and approaches expressed above can be seen as guideposts for providing ethical use of AI and other types of technology with respect to workers, but much more is needed to translate and implement these principles (Deranty and MacMillan 2012). These efforts will involve designers, developers, and employers who foster ethically designed technology and the workers who use it (Mitteldstadt et al. 2016). While following the principles expressed herein will be difficult, there are examples where it is beginning to take shape in real-world practice (Howard and Schulte 2024).

There is a need to encourage and ensure employer and decision-maker behaviors that comport with the ethical principles of nonmaleficence, beneficence, autonomy, justice, and respect for persons discussed in this paper. This may occur across technology design, production, development, implementation, and long-term use. Below are considerations for next steps to enhance the position of work-related technoethics in support of a future conducive to decent work for all. These steps include the widespread normalization and adoption of technoethical education, regular ethical technology assessments (eTAs), the integration of ethical foresight analysis (EFA) into research and practice, and revisions to ethical standards and guidance.

Fundamental technoethical education

The impetus to invest in technoethical training and education arises from the increasing demand for

businesses to use ethical practices with emerging technology (Moor 2005; Sekerka 2009; Wilk 2019; Guszcza et al. 2020; Skonnard 2024). Ideally, technology should be designed and implemented in ways that reflect the social, cultural, and ethical values of the society where it will be deployed (Guszcza et al. 2020). To build a culture with a human-centered view of technology, technoethical discourse could begin in early education programs when automation and digitization are first introduced to children in developed countries (Krutka et al. 2019) and continue across the education continuum. Demand for such information in university courses has already been expressed (Singer 2018). Organizations (business and labor) can further educate workers on the societal, legal, and ethical impacts of working with and alongside new and emerging technology before it is adopted and implemented (Floridi et al. 2018). Management could also collaborate with workers to implement transparent technological oversight processes (Winfield and Jirotka 2018).

Ethical technology assessments

eTAs can enhance traditional risk-assessment strategies by helping proactively identify ethical issues that may arise from implementing new technology (Brey 2012). These assessments are most useful during the early stages of technology development. One approach uses a formalized checklist to guide the evaluation of nine predetermined critical ethical areas, including control (a facet of autonomy) as well as privacy and impact to disadvantaged groups (both elements of justice) (Palm and Hansson 2006). Some human-centered approaches suggest including an assessment of the social impact of technology as well (Maurice et al. 2018). Subsequent repeated eTAs are encouraged to continuously analyze the ethical (and social) implications of technology as it evolves over time (Floridi and Strait 2020). Parties best positioned to identify and address ethical issues in work-related technology use include technology developers, technology implementers in the workplace, and policymakers (Institute of Electrical and Electronics Engineers (IEEE) 2019). Integrating multiple perspectives on transdisciplinary risk-assessment teams that are trained to perform eTAs may maximize their meaningful contributions to risk mitigation associated with technology.

Ethical foresight analysis

As a complement to eTAs, EFA is needed to explore longer-term ethical issues related to emerging work-related technology (Floridi and Strait 2020). EFA is an extension of strategic foresight, a future studies practice designed to help understand, prepare for, and influence the future (Iden et al. 2017). Strategic foresight includes a toolbox of activities designed to help answer thought-provoking questions about future possibilities (Futures School 2023). This reflective practice can expand how to think about the future and develop plans in pursuit of preferred future states (Bishop and Hines 2012).

EFA is well situated to serve both purposes in support of a future defined by decent work for all. It can support evaluation of ethical considerations for new or emerging technology and identify possible interventions to address technology-related risks (Floridi and Strait 2020).

Consideration of EFA raises questions of who might conduct such analyses. The answer is likely multiple actors: authorities, employers, designers, insurers, and workers. These parties may also work collaboratively to translate EFA results into practices and policies that positively impact the design and implementation of technology for decent work.

Revisions to ethical standards and guidance

Although there seems to be broad agreement that an ethical approach to technology is appropriate, consensus on exactly what that means has not yet been reached. Perspectives differ on the ethical requirements and standards for technology and the definitions for guiding technoethical principles (Jobin et al. 2019). There is much work to be done to develop unified standards and guidance to support the pursuit of decent work.

New and emerging workplace technology may require higher ethical standards or at least a revised ethical code (Herkert 2010; Iavicoli et al. 2018). A "business as usual" approach to ethical standards is not advised for periods of rapid and pronounced change associated with technology (Moor 2005). Instead, increased understanding of the benefits and consequences of new technology and more proactive plans to address them are needed (Howard and Schulte 2024). This need is especially important when it comes to workers, who are often the first group exposed to new technology and often to greater extents than the rest of society. Human-centered codes with force and accountability can help ensure ethical issues are considered in all technology use cases (Campolo et al. 2017). Industry may benefit from legal and contractual guidance and access to best practices with respect to human–machine collaborations in the workplace (Floridi et al. 2018).

Discussion and conclusions

The future of work is characterized as rife with potential psychosocial hazards stemming from technology (Schulte et al. 2020, 2022). The more technology becomes embedded in and influences work, the more its design and use need to be assessed to address threats to

decent work, autonomy, and justice; failure to be beneficent; increased maleficence; and lack of respect for persons. Decent work builds on the rights of workers to work with dignity, freedom, fairness and voice.

Technology continues to transform the day-to-day lives of workers around the world (Violini et al. 2020). It has become a driver and enabler of almost every aspect of work. The intersection of technology and the humane treatment of workers may present new ethical issues that need consideration. Exploration of new technology, however, needs to be contextualized with respect to the socioeconomic and political contexts in which it is developed and implemented (Jasanoff 2021).

While various sets of principles have been developed related to technology (Future of Life Institute 2017; University of Montreal 2018; The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems 2019; Council of the European Union 2024; United Nations 2024), none comprehensively address the ethical issues of technology use in the workplace and its impact on workers. There have been efforts to promote human-centered AI in the workplace, including worldwide guidance on the adoption of values that emphasize human agency and control for technology users, especially users of AI (Trades Union Congress 2021; Krzywdzinski et al. 2022). Recent analysis and insights on algorithms at work are a step toward concrete action in this area (Kellogg et al. 2020).

To further prepare for the future of work and promote opportunities for decent work, it is particularly important to identify and provide guidance on the ethical challenges that technology presents. There is a need for increased competency in the decent work conditions of security, freedom, equity, and human dignity—and their undergirding ethical principles—among those who design, develop, and implement technology in the workplace and for those who are responsible for monitoring its impact. Additional discourse is also needed to identify who the responsible parties are, how to bring them together for collaboration, and what strategic plans and actions might help move toward a future defined by decent work for all. The authors of this paper encourage application of other technological and ethical frameworks to yield additional insights on this topic and add to the discourse begun here. Follow-on research might also consider developing a functional ethical framework for decent work specifically focused on occupational safety and health.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, or other affiliated organizations of the authors.

Conflict of interest

The authors declare no conflicts of interest.

Data availability

No data were used in this study.

References

Anderson J, Rainie L. 2023. The future of human agency. [accessed 11 January 2024]. https://www.pewresearch.org/internet/2023/02/24/the-future-of-human-agency/

Autiero A. 2020. Human dignity in an ethical sense: basic considerations. Interdisciplinary J Religion Transform Contemporary Soc. 6:9–21. https://doi.org/10.30965/23642807-00601002

Azais C. 2011. Subordination or autonomy? The hybridisation of the labour market—the italian case. In: Azais C, editor. Labour and employment in a globalising world autonomy, collectives and political dilemmas. P.I.E. Peter Lang. p. 165–183.

Bailey DE. 2022. Emerging technologies at work: policy ideas to address negative consequences for work, workers, and society. ILR Rev. 75:527–551. https://doi.org/10.1177/00197939221076747

Baiocco S, Fernandez-Macias E, Rani U, Pesole A. 2022. The algorithmic management of work and its implications in different contexts (background paper no 9). International Labour Organization. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_849220.pdf

Ball K. 2021. Electronic monitoring and surveillance in the workplace: literature review and policy recommendations. Publications Office of the European Union. https://doi.org/10.2760/5137

Balliester T, Elsheikhia A. 2018. The future of work: a literature review [working paper no 29]. International Labour

Organization. https://www.ilo.org/global/research/publications/working-papers/WCMS_625866/lang--en/index.htm

Baumer E. 2017. Toward human-centered algorithmic design. Big Data Soc. 4:1–12. https://doi.org/10.1177/2053951717718854

Beauchamp T, Childress J. 2019. Principles of biomedical ethics. 8th ed. Oxford University Press.

Bernstein E, Lee M, Minnaar J. 2022. How companies are using tech to give employees more autonomy. Harv Bus Rev Jan:1. https://hbr.org/2022/01/how-companies-are-using-tech-to-give-employees-more-autonomy

Beunza D. 2019. Taking the floor: models, morals, and management in a wall street trading room. Princeton University Press. https://books.google.com/books?id=gyWMDwAAQBAJ

Bishop P, Hines A. 2012. Teaching about the future. Palgrave Macmillan.

EU-OSHA, et al. 2018. Foresight on new and emerging occupational safety and health risks associated with digitalisation by 2025. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/dce30031-1946-11e9-8d04-01aa75ed71a1/language-en

Braganza A, Chen W, Canhoto A, Sap S. 2021. Productive employment and decent work: the impact of AI adoption on psychological contracts, job engagement and employee trust. J Bus Res. 131:485–494. https://doi.org/10.1016/j.jbusres.2020.08.018

Bresciani S, Ferraris A, Huarng K, Makhotra A. 2021. Digital transformation as a springboard for product, process, and business model innovation. J Bus Res. 128:204–210. https://doi.org/10.1016/j.jbusres.2021.02.003

Brey P. 2012. Anticipatory technology ethics for emerging technologies. Nanoethics. 6:1–13. https://doi.org/10.1007/s11569-012-0141-7

British Academy/Royal Society. 2018. The impact of artificial intelligence on work. British Academy/Royal Society.

Bucher E, Schou P, Waldkirch M. 2021. Pacifying the algorithm—anticipatory compliance in the face of algorithmic management in the gig economy. Organization. 28:44–67. https://doi.org/10.1177/1350508420961531

Burr C, Taddeo M, Floridi L. 2019. The ethics of digital well-being: a thematic review. Sci Eng Ethics. 26:2313–2343. https://doi.org/10.1007/s11948-020-00175-8

Calvo R, Peters D, Vold K, Ryan R. 2020. Supporting human autonomy in AI systems: a framework for ethical inquiry. In: Burr C, Floridi L, editors. Ethics of digital well-being: philosophical studies series 140. p. 31–54.

Campa R. 2019. Three scenarios of the future of work: technological unemployment, compensation, hollowing out. Sociol Technosci. 9:140–154. https://doi.org/10.24197/st.2.2019.140-154

Campolo A, Sanfilippo M, Whittaker M, Crawford K. 2017. AI Now 2017 report. AI Now Institute at New York University.

Capasso M. 2023. Responsible social robotics and the dilemma of control. Int J Soc Robotics. 15:1981–1991. https://doi.org/10.1007/s12369-023-01049-2

Caruso L. 2018. Digital innovation and the fourth industrial revolution: epochal social changes? . AI Soc. 33:379–392. https://doi.org/10.1007/s00146-017-0736-1

Cebulla A, Szpak Z, Howell C, Knight G, Hussain S. 2023. Applying ethics to AI in the workplace: the design of a scorecard for australian workplace health and safety. AI Soc. 38:919–935. https://doi.org/10.1007/s00146-022-01460-9

Chen Z. 2023a. Collaboration among recruiters and artificial intelligence: removing human prejudices in employment. Cognition Technol Work (Online). 25:135–149. https://doi.org/10.1007/s10111-022-00716-0

Chen Z. 2023b. Ethics and discrimination in artifical intelligence-enabled recruitment practices. Humanities Soc Sci Commun. 10:567. https://doi.org/10.1057/s41599-023-02079-x

Cheng W-J, Pien L-C, Cheng Y. 2021. Occupation-level automation probability is associated with psychosocial work conditions and workers' health: a multilevel study. Am J Ind Med. 64:108–117. https://doi.org/10.1002/ajim.23210

Cheraghi R, Valizadeh L, Zamanzadeh V, Hassankhani H, Jafarzadeh A. 2023. Clarification of ethical principle of the beneficence in nursing care: an integrative review. BMC Nurs. 22:89. https://doi.org/10.1186/s12912-023-01246-4

Chia G, Lim S, Sng G, Hwang Y-FJ, Chia K. 2019. Need for a new workplace safety and health (WSH) strategy for the fourth industrial revolution. Am J Ind Med. 62:275–281. https://doi.org/10.1002/ajim.22960

Collingridge D. 1980. The social control of technology. St. Martin's Press.

Constantinides M, Quercia D. 2022. Good intentions, bad inventions: how employees judge pervasive technologies in the workplace. IEEE Pervasive Comput. 22:69–76. https://arxiv.org/pdf/2210.06381.pdf

Council of the European Union. 2024. Artificial intelligence act. [accessed 8 March 2024]. https://data.consilium.europa.eu/doc/document/ST-5662-2024-INIT/en/pdf

Crain T, Brossoit R, Robles-Saenz F, Tran M. 2020. Fighting fatigue: a conceptual model of driver sleep in the gig economy. Sleep Health. 6:358–365. https://doi.org/10.1016/j.sleh.2020.02.004

D'Cruz P, et al. 2022. Technology, megatrends and work: thoughts on the future of business ethics. J Business Ethics. 180:870–902. https://doi.org/10.1007/s10551-022-05240-9

Daheim C, Wintermann O. 2019. Work 2050: three scenarios. New findings of an international Delphi study of the millennium project. [accessed 17 January 2024]. https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/ST-BS_Delphi-2019_Englisch.pdf

Daily M, Oulasvirta A, Rekimoto J. 2017. Technology for human augmentation. Computer. 50:12–15. https://doi.org/10.1109/MC.2017.39

Danaher J. 2019. The rise of robots and the crisis of moral patiency. AI Soc. 34:129–136. https://doi.org/10.1007/s00146-017-0773-9

Dantas C, van Staalduinen W, Machado N, Jegundo A, Rodrigues F. 2019. Older workers, technology and the balance of power: an ethical review. PETRA'19: Proceedings of the 12th ACM International Conference on PErvasive Technologies Related to Assistive Enviornments. p. 464–467. https://doi.org/10.1145/3316782.3322770

De Stefano V, Taes S. 2023. Algorithmic management and collective bargaining. Transfer. 29:21–36. https://doi.org/10.1177/10242589221141055

Dellot B. 2018. Why automation is more than just a job killer. [accessed 24 February 2024]. https://www.thersa.org/

blog/2018/07/the-four-types-of-automation-substitution-augmentation-generation-and-transference

Dellot B, Mason R, Wallace-Stephens F. 2019. The four futures of work. Coping with uncertainty in an age of radical technologies. [accessed 17 January 2024]. https://www.thersa.org/globalassets/pdfs/reports/rsa_four-futures-of-work.pdf

Deranty J-P, MacMillan C. 2012. The ILO's decent work initiative: suggestions for an extension of the notion of "decent work". J Soc Philos. 43:386–405. https://doi.org/10.1111/josp.12003

Dhirani LL, Mukhtiar N, Chowdhry BS, Newe T. 2023. Ethical dilemmas and privacy issues in emerging technologies: a review. Sensors. 23:1151. https://doi.org/10.3390/s23031151

Di Ruggerio E, Cohen J, Cole D, Forman L. 2015. Public health agenda setting in a global context: the International Labor Organization's decent work agenda. Am J Public Health. 105:e58–e61. https://doi.org/10.2105/AJPH.2014.302455

Disselkamp L. 2020. Ethics and the future of workforce management. [accessed 18 January 2024]. https://workforce.com/news/ethics-and-the-future-of-workforce-management

Djankov S, Saliola F. 2019. The changing nature of work. J Int Affairs. 72:57–73.

Dubal V. 2022. Economic security & the reguation of gig work in california: from ab5 to proposition 22. Eur Labour Law J. 13:51–65. https://doi.org/10.1177/20319525211063111

Dunn M, Munoz I, Jarrahi M. 2023. Dynamics of flexible work and digital platforms: task and spatial flexibility in the platform economy. Digital Business. 3:100052. https://doi.org/10.1016/j.digbus.2022.100052

Dusek V. 2006. Philosophy of technology: an introduction. Blackwell Publishing.

España S, van der Maaten C, Gulden J, Pastor O. 2023. A survey of ethical reasoning methods, their metamodels, and a discussion on their application to conceptual modelling. In: Almeida JPA, Borbinha J, Guizzardi G, Link S, Zdravkovic J, editors. Conceptual modeling: 42nd international conference (proceedings). Springer-Verlag. p. 23–44.

Eurofound. 2018. Automation, digitalisation and platforms: implications for work and environment. https://www.eurofound.europa.eu/en/publications/2018/automation-digitisation-and-platforms-implications-work-and-employment

European Commission. n.d. Advanced technologies. [accessed 3 April 2024]. https://single-market-economy.ec.europa.eu/industry/strategy/advanced-technologies_en

Faraj S, Pachidi S. 2020. Beyond uberization: the co-constitution of technology and organizing. Organ Theory. 2:1–14. https://doi.org/10.1177/2631787721995205

Fisher E, Flynn MA, Pratap P, Vietas J. 2023. Occupational safety and health equity impacts of artificial intelligence: a scoping review. Int J Environ Res Public Health. 20:6221. https://doi.org/10.3390/ijerph20136221

Floridi L, et al. 2018. Ai4people—an ethical framework for a good AI society: opportunities, risks, principles, and recommendations. Minds Mach. 28:689–707. https://doi.org/10.1007/s11023-018-9482-5

Floridi L, Strait A. 2020. Ethical foresight analysis: what it is and why it is needed? Minds Mach. 30:77–97. https://doi.org/10.1007/s11023-020-09521-y

Friedman C. 2023. Ethical concerns with replacing human relations with humanoid robots: an ubuntu perspective. AI Ethics. 3:527–538. https://doi.org/10.1007/s43681-022-00186-0

Friedman M. 2006. Autonomy, gender, and politics: studies in feminist philosophy. Oxford University Press.

Fu Y, et al. 2021. Distributed scheduling problems in intelligent manufacturing systems. Tsinghua Sci Technol. 26:625–645. https://doi.org/10.26599/tst.2021.9010009

Future of Life Institute. 2017. Asilomar AI principles. [accessed 8 March 2024]. https://futureoflife.org/open-letter/ai-principles/

Futures School. 2023. Can we count on the future? [accessed 19 January 2023]. https://www.youtube.com/watch?v=p9grlf3CFks

Ghislieri C, Molino M, Cortese C. 2018. Work and organizational psychology looks at the fourth industrial revolution: how to support workers and organizations? Front Psychol. 9:2365. https://doi.org/10.3389/fpsyg.2018.02365/full

Gibbs J, Kirkwood G, Fang C, Wilkenfeld J. 2021. Negotiating agency and control: theorizing human-machine communication from a structurational perspective. Human-Machine Commun. 2:153–171. https://doi.org/10.30658/hmc.2.8

Glavin P, Bierman A, Schieman S. 2021. Uber-alienated: powerless and alone in the gig economy. Work Occup. 48:399–431. https://doi.org/10.1177/07308884211024711

Grimshaw D. 2020. International organsations and the future of work: how new technologies and inequality shaped the narratives in 2019. J Ind Relat. 62:477–507. https://doi.org/10.1177/0022185620913129

Guszcza J, Lee MA, Beena Ammanath B, Kuder D. 2020. Human values in the loop: design principles for ethical AI. Deloitte. [accessed 22 January 2024]. https://www2.deloitte.com/content/dam/Deloitte/de/Documents/human-capital/Deloitte_Review_26_Human_values_in_the_loop.pdf

Healy J, Nicholson D, Gahan P. 2017. The future of work in australia: anticipating how new technologies will reshape labour markets, occupations and skill requirements. [accessed 22 January 2024]. https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/education-for-a-changing-world/media/documents/The-Future-of-Work-in-Australia-Executive-Summary.pdf

Heikkerö T. 2006. Ethics of risks. Kristin Schrader-Frechette's philosophical critique of risk assessment (NEI-SE-613). In: Anderson K, editor. [accessed 22 January 2024]. https://inis.iaea.org/collection/NCLCollectionStore/_Public/37/101/37101559.pdf?r=1

Herbert W, Tuminaro A. 2008. The impact of emerging technologies in the workplace: who's watching the man (who's watching me)? Hofstra Labor Employment Law J. 25:355–393. https://law.hofstra.edu/pdf/academics/journals/laborandemploymentlawjournal/labor_vol25no2_herbert.pdf

Herkert JR. 2010. Ethical challenges of emerging technologies. In: Marchant GE, Allenby BR, Herkert JR, editors. The growing gap between emerging technologies and legal-ethical oversight: the pacing problem. Springer. p. 35–44. https://www.researchgate.net/publication/226241291_Ethical_Challenges_of_Emerging_Technologies

High Level Expert Group (HLEG). 2019. Ethics guidelines for trustworthy AI. European Commission. https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

Hopkins J. 2024. Managing the right to disconnect—a scoping review. Sustainability. 16:4970. https://doi.org/10.3390/su16124970

Hosseini Z, Nyholm S, Le Blanc P, Preenen P, Demerouti E. 2023. Assessing the artificially intelligent workplace: an ethical framework for evaluating experimental technologies in workplace settings. AI Ethics 4:285. https://doi.org/10.1007/s43681-023-00265-w

Howard J. 2022. Algorithms and the future of work. Am J Ind Med. 65:943–952. https://doi.org/10.1002/ajim.23429

Howard J, Schulte P. 2024. Managing workplace AI risks and the future of work. Am J Ind Med. 67:980–993. https://doi.org/10.1002/ajim.23653

Iavicoli S, Valenti A, Gagliardi D, Rantanen J. 2018. Ethics and occupational health in the contemporary world of work. Int J Environ Res Public Health. 15:1713. https://doi.org/10.3390/ijerph15081713

Iden J, Methlie L, Christensen G. 2017. The nature of strategic foresight research: a systematic literature review. Technol Forecaseing Social Change. 116:87–97. https://doi.org/10.1016/j.techfore.2016.11.002

The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems. 2019. Ethically aligned design: a vision for prioritizing human well-being with autonomous and intelligent systems. [accessed 8 March 2024]. https://sagroups.ieee.org/global-initiative/wp-content/uploads/sites/542/2023/01/ead1e.pdf

Ihde D. 1991. Instrumental realism: the interface between philosophy of science and philosophy of technology. Indiana University Press.

Inclusive Design Research Centre. n.d. IDRC's inclusive artificial intelligence (AI) initiatives. [accessed 4 April 2024]. https://wecount.inclusivedesign.ca/

Institute of Electrical and Electronics Engineers (IEEE). 2019. Ethically aligned design. [accessed 24 January 2024]. https://standards.ieee.org/wp-content/uploads/import/documents/other/ead_v2.pdf

International Labour Organization (ILO). 1999. Report of the director-general: decent work. [accessed 22 February 2024]. https://www.ilo.org/public/english/standards/relm/ilc/ilc87/rep-i.htm

International Labour Organization (ILO). 2013. Decent work is a human right. ILO statement to the third committee of the 68th general assembly. [accessed 22 February 2024]. https://www.ilo.org/newyork/speeches-and-statements/WCMS_229015/lang--en/index.htm

International Labour Organization (ILO). 2022. ILO declaration on social justice for a fair globalization. [accessed 30 August 2024]. https://www.ilo.org/resource/ilo-declaration-social-justice-fair-globalization

International Labour Organization (ILO). (n.d.). Decent work. [accessed 26 January 2024]. https://www.ilo.org/global/topics/decent-work/lang--en/index.htm

Jafari SA, et al. 2024. The challenges of research in the field of human dignity. J Med Ethics History Med. 17:1. https://doi.org/10.18502/jmehm.v17i4.17103

Jarrahi M. 2019. In the age of smart artificial intelligence: AI's dual capacities for automating and informing work. Bus Inf Rev. 36:178–187. https://doi.org/10.1177/02663821198839

Jasanoff S. 2021. Keynote: science and emerging technology for inclusive transition: new directions. [accessed 31 January 2024]. https://www.oecd-events.org/technology-in-and-for-society/onlinesession/9602aaff-c4d5-eb11-94b3-000d3a21a507

Jetha A, et al. 2023a. Artificial intelligence and the work–health interface: a research agenda for a technologically transforming world of work. Am J Ind Med. 66:815–830. https://doi.org/10.1002/ajim.23517

Jetha A, et al. 2023b. Divided in a digital economy: understanding disability employment inequities stemming from the application of advanced workplace technologies. SSM—Qual Res Health. 3:100293. https://doi.org/10.1016/j.ssmqr.2023.100293

Jnaneswar K, Ranjit G. 2022. Organizational justice and organizational citizenship behavior: the mediating role of psychological ownership. J Organ Effect. 9:1–19. https://doi.org/10.1108/JOEPP-01-2021-0012

Jobin A, Ienca M, Vayena E. 2019. The global landscape of AI ethics guidelines. Nat Mach Intell. 1:389–399. https://doi.org/10.1038/s42256-019-0088-2

Johansson J, et al. 2017. Work and organization in a digital industrial context. Manag Rev. 28:281–297. https://doi.org/10.5771/0935-9915-2017-3-281.

Kellogg KC, Valentine MA, Christin A. 2020. Algorithms at work: the new contested terrain of control. Acad Manage Annals. 14:366–410. https://doi.org/10.5465/annals.2018.0174

Kendal E. 2022. Ethical, legal and social implications of emerging technology (ELSIET) symposium. J Bioethical Inquiry. 19:363–370. https://doi.org/10.1007/s11673-022-10197-5

Kolade O, Owoseni A. 2022. Employment 5.0: the work of the future and the future of work. Technol Soc. 71:102086. https://doi.org/10.1016/j.techsoc.2022.102086

Kreuzwieser S, et al. 2023. Human-machine-interaction in innovative work environment 4.0: a human-centered approach. In: Shajek A, Hartmann E, editors. New digital work: digital sovereignty at the workplace. Springer. p. 68–86.

Krutka D, Heath M, Willet K. 2019. Foregrounding technoethics: toward critical perspectives in technology and teacher education. J Technol Teach Educ. 27:555–574. https://www.learntechlib.org/primary/p/208235/.

Krzywdzinski M, Gerst D, Butollo F. 2022. Promoting human-centered AI in the workplace. Trade unions and their strategies for regulating the use of AI in germany. Transfer. 29:53–70. https://doi.org/10.1177/10242589221142273

Latos B, et al. 2018. Complexity drivers in digitalized work systems: implications for cooperative forms of work. Adv Sci Technol Eng Syst J. 3:166–185. https://doi.org/10.25046/aj030522

le Feber M, Jadoenathmisier T, Goede H, Kuijpers E, Pronk A. 2020. Ethics and privacy considerations before deploying sensor technologies for exposure assessment in the workplace: results of a structured discussion amongst dutch stakeholders. Ann Work Expo Health. 65:3–10. https://doi.org/10.1093/annweh/wxaa093

Lewis EO, MacKenzie D, Kaminsky J. 2021. Exploring equity: how equity norms have been applied implicitly and

explicitly in transportation research and practice. Transp Res Interdiscip Perspect. 9:100332. https://doi.org/10.1016/j.trip.2021.100332

Lim W. 2023. The workforce revolution: reimagining work, workers, and workplaces for the future. Glob Bus Organ Excell. 42:5–10. https://doi.org/10.1002/joe.22218

Lindholm M, Reimanb A, Väyrynen S. 2020. On future occupational safety and health challenges in industrialized countries: a systematic literature review. Int J Occup Environ Safety. 4:108–127. https://doi.org/10.24840/2184-0954_004.001_0009

Longo F, Padovano A, Umbrello S. 2020. Value-oriented and ethical technology engineering in industry 5.0: a human-centric perspective for the design of the factory of the future. Appl Sci. 10:4182. https://doi.org/10.3390/app10124182

Lucas D, Bellavitis C, Park U. 2023. A cloud's silver lining? The impact of policy interventions on new and maturing technology ventures' online recruitment. Strategic Entreprenurship J. 17:445–484. https://doi.org/10.1002/sej.1454

Manyika J, et al. 2017. A future that works: automation, employment, and productivity. McKinsey & Company. https://www.mckinsey.com/~/media/mckinsey/featured%20insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works-Executive-summary.ashx

Marsh E, Vallejos E, Spence A. 2022. The digital workplacfe and its dark side: an integrative review. Comput Hum Behav. 128:107118. https://doi.org/10.1016/j.chb.2021.107118

Maurice P, Allienne L, Malaise A, Ivaldi S. 2018. Ethical and social considerations for the introduction of human-centered technologies at work. Paper presented at: IEEE Workshop on Advanced Robotics and its Social Impacts (ARSO); Genova, Italy. p. 131–138. https://doi.org/10.1109/arso.2018.8625830

McKinsey & Company. 2023. What is the future of work? [accessed 30 August 2024]. https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-the-future-of-work#/

Meda D. 2019. Three scenarios for the future of work. Int Lab Rev. 158:627–652. https://doi.org/10.1111/ilr.12157

Mitteldstadt B, Allo P, Taddeo M, Wachter S, Floridi L. 2016. The ethics of algorithms: mapping the debate. Big Data Soc. 3:1. https://doi.org/10.1177/2053951716679679

Mittelstadt BD, Stahl BC, Fairweather NB. 2015. How to shape a better future? Epistemic difficulties for ethical assessment and anticipatory governance of emerging technologies. Ethical Theory Moral Pract. 18:1027–1047. https://doi.org/10.1007/s10677-015-9582-8.

Moor JH. 2005. Why we need better ethics for emerging technologies. Ethics Inf Technol. 7:111–119. https://doi.org/10.1007/s10676-006-0008-0

Moore D, Haines K, Drudik J, Arter Z, Foley Z. 2020. Upskill/backill model of career pathways advancement: the nebraska vocational rehabilitation approach. J Appl Rehabil Counseling. 5:1. https://doi.org/10.1891/JARC-D-20-00002

Moore P. 2019. Osh and the future of work: benefits and risks of artificial intelligence tools in workplaces. European Agency for Safety and Health at Work (EU-OSHA). https://osha.europa.eu/sites/default/files/2021-11/OSH_future_of_work_artificial_intelligence.pdf

Morena E, Krause D, Stevis D, editors. 2020. Just transitions: social justice in the shift towards a low-carbon world. Pluto Press.

Neffke F, Nedelkoska L, Widerhold S. 2023. Skill mismatch and the costs of job displacement: IWH discussion papers, no 11/2023. Halle Institute for Economic Research (IWH). https://www.econstor.eu/bitstream/10419/281110/1/iwh-dp2023-11rev.pdf

Newlands G. 2021. Algorithmic surveillance in the gig economy: the organization of work through Lefebvrian conceived space. Organ Stud. 42:719–737. https://doi.org/10.1177/0170840620937900

NIOSH. 2023. Module 5. Legal-ethical considerations to promote safe working conditions. Safety culture in healthcare settings. NIOSH Pub No 2023-15. https://www.cdc.gov/niosh/learning/safetyculturehc/module-5/1.html

Nordmann A. 2004. Converging technologies: shaping the future of European societies (Eur 21357). European Commission No. 92-894-8313-X. https://pure.iiasa.ac.at/id/eprint/12590/1/Converging%20Technologies.pdf

Nukaga Y. 2019. Devleopement of the hybrid rule and the concept of justice: the selection of subjects in biomedical research. Perspect Sci. 27:891–924. https://doi.org/10.1162/posc_a_00329

Ogar J, Idagu U, Bassey S. 2018. Ethics in a technological society. J Sustain Soc. 7:1–4. https://doi.org/10.11634/216825851504930

Palm E, Hansson S. 2006. The case for ethical technology assessment (ETA). Technol Forecast Soc Change. 73:543–558. https://doi.org/10.1016/j.techfore.2005.06.002

Parente M, Figueira G, Amorim P, Marques A. 2020. Production scheduling in the context of industry 4.0: review and trends. Int J Prod Res. 58:5401–5431. https://doi.org/10.1080/00207543.2020.1718794

Patel V, Chesmore A, Legner C, Pandey S. 2022. Trends in workplace wearable technologies and connected-worker solutions for next-generation occupational safety, health, and productivity. Adv Intell Syst. 4:2100099. https://doi.org/10.1002/aisy.202100099

Pham Q-C, Madhavan R, Righetti L, Smart W, Chatila R. 2018. The impact of robotics and automation on working conditions and employment (ethical, legal, and societal issues). IEEE Robot Autom Mag. 25:126–128. https://doi.org/10.1109/MRA.2018.2822058

Ra S, Shrestha U, Khatiwada S, Yoon S, Kwon K. 2019. The rise of technology and impact on skills. Int J Training Res. 51:26–40. https://doi.org/10.1080/14480220.2019.1629727

Rantanen J, Muchiri F, Lehtinen S. 2020. Decent work, ILO's response to the globalization of working life: basic concepts and global implementation with special reference to occupational health. Int J Environ Res Public Health. 17:3351. https://doi.org/10.3390/ijerph17103351

Roco MC, Bainbridge WS, editors. 2002. Converging technologies for improving human performance: nanotechnology, biotechnology, information technology and cognitive science. NSF report. [accessed 16 February 2024]. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/bioecon-%28%23%20023SUPP%29%20NSF-NBIC.pdf

Rosenfield CL. 2011. Informational work autonomy: freedom or control? In: Asais C, editor. Labour and employment in a globalising world autonomy, collectives and political dilemmas. P.I.E. Peter Lang. p. 151–164.

Rousseau DM. 1995. Psychological contracts in organizations: understanding written and unwritten agreements. SAGE Publications, Inc.

Sawant R, Thomas B, Kadlag S. 2022. Reskilling and upskilling: to stay relevant in today's indjstry. Int Rev Business Econ. 7:4. https://doi.org/10.56902/IRBE.2022.7.1.4.

Schmid Y, Dowling M. 2020. New work: new motivation? A comprehensive literature review on the impact of workplace technologies. Manage Rev Quart. 72:59–86. https://doi.org/10.1007/s11301-020-00204-7

Schmitz S, Schluetter M, Epple U. 2009. Automation of automation—definition, components and challenges. IEEE Conference on Emerging Technologies & Factory Automation; 2009; Palma de Mallorca, Spain. https://doi.org/10.1109/ETFA.2009.5347197

Schulte P, et al. 2020. Potential scenarios and hazards in the work of the future: a systematic review of the peer-reviewed and gray literatures. Ann. Work Expo. Health. 64:786–816. https://doi.org/10.1093/annweh/wxaa051

Schulte P, et al. 2022. Expanding the focus of occupational safety and health: lessons from a series of linked scientific meetings. Int J Environ Res Public Health. 19:15381. https://doi.org/10.3390/ijerph192215381

Schulte P, Salamanca-Buentello F. 2007. Ethical and scientific issues of nanotechnology in the workplace. Environ Health Perpect. 115:5–12. https://doi.org/10.1289/ehp.9456.

Sekerka L. 2009. Organizational ethics education and training: a review of best practices and their application. Int J Training Develop. 13:77–95. https://doi.org/10.1111/j.1468-2419.2009.00319.x

Singer N. 2018. Tech's ethical 'dark side': Harvard, Stanford, and others want to address it. New York Times. https://www.nytimes.com/2018/02/12/business/computer-science-ethics-courses.html

Singh A, Jha S, Srivastava D, Somarajan A. 2022. Future of work: a systematic literature review and evolution of themes. Foresight. 24:99–125. https://doi.org/10.1108/FS-09-2020-0093

Skonnard A. 2024. Why responsible AI innovation starts with ethical technologists. Forbes. [accessed 4 September 2024]. https://www.forbes.com/councils/forbestechcouncil/2024/02/09/why-responsible-ai-innovation-starts-with-ethical-technologists/

Stiles P, Scott E, Debata P. 2025. Technology, capitalism, and the social contract. Bus Ethics Environ Responsib 34:32–42. https://doi.org/10.1111/beer.12567

Subramani S, Biller-Andorno N. 2022. Revisiting respect for persons: conceptual analysis and implications for clinical practice. Med Health Care Philos. 25:351–360. https://doi.org/10.1007/s11019-022-10079-y

Swierstra T, Rip A. 2007. Nano-ethics as nest-ethics: patterns of moral argumentation about new and emerging science and technology. Nanoethics. 1:3–20. https://doi.org/10.1007/s11569-007-0005-8

Tamers S, et al. 2020. Envisioning the future of work to safeguard the safety, health, and well-being of the workforce: a perspective from the CDC's national institute for occupational safety and health. Am J Ind Med. 63:1065–1084. https://doi.org/10.1002/ajim.23183

Taylor A. 2018. The faux-bot revolution. In: Dellot B, editor. A field guide to the future of work. RSA. p. 12–16. https://www.thersa.org/globalassets/pdfs/reports/rsa_field-guide-future-work.pdf

Todoli-Signes A. 2021. Making algorithms safe for workers: occupational risks associated with work managed by artificial intelligence. Transfer. 27:433–452. https://doi.org/10.1177/10242589211035040

Torreson J. 2018. A review of future and ethical perspectives of robots and AI. Front Robotics AI. 4:75. https://doi.org/10.3389/front.2017.00075

Trades Union Congress. 2021. Dignity at work and the AI revolution. [accessed 7 February 2024]. https://www.tuc.org.uk/sites/default/files/2021-03/The_AI_Revolution_20121_Manifesto_AW.pdf

Traumer F, Oeste-Reib S, Leimeister J. 2017. Towards a future reallocation of work between humans and machines—taxonomy of tasks and interaction types in the context of machine learning. https://aisel.aisnet.org/icis2017/TransformingSociety/Presentations/14/

Ulhoi J, Norskov S. 2022. The emergence of social robots: adding physicality to technology. J Eng Technol Manage. 65:101703. https://doi.org/10.1016/j.jengtecman.2022.101703

United Nations. 1948. United nations declaration of human rights, un general assembly, universal declaration of human rights, 10 december 1948, 217 a (iii). [accessed 15 February 2024]. https://www.refworld.org/legal/resolution/unga/1948/en/11563

United Nations. 2015. Transforming our world: the 2030 agenda for sustainable development. [accessed 15 February 2024]. https://sdgs.un.org/2030agenda

United Nations. 2024. Resolution a/78/l.49: seizing the opportunities of safe, secure and trustworthy artificial intelligence systems for sustainable development. [accessed 3 April 2024]. https://documents.un.org/doc/undoc/ltd/n24/065/92/pdf/n2406592.pdf?token=kyicMfZttFSHrReHCn&fe=true

United Nations. n.d. United nations global compact. [accessed 23 February 2024]. https://unglobalcompact.org/

University of Montreal. 2018. Montreal declaration for a responsible development of artificial intelligence. [accessed 8 March 2024]. https://declarationmontreal-iaresponsable.com/wp-content/uploads/2023/04/UdeM_Decl_IA-Resp_LA-Declaration-ENG_WEB_09-07-19.pdf

van de Poel I. 2016. An ethical framework for evaluating experimental technology. Sci Eng Ethics. 22:667–686. https://doi.org/10.1007/s11948-015-9724-3

van Zyl L, van der Vaart L, Stemmert L. 2017. Positive psychological interventions aimed at enhancing psychological ownership. In: Olckers C, van Zyl L, van der Vaart L, editors. Theoretical orientations and practical applciations of psychological ownership. Cham. p. 119–134.

Varkey B. 2021. Principles of clinical ethics and their application to practice. Med Princ Pract. 30:17–28. https://doi.org/10.1159/000509119

Violini E, et al. 2020. The social enterprise at work: paradox as a path forward. Deloitte Insights. https://www2.deloitte.com/

content/dam/Deloitte/at/Documents/human-capital/at-hc-trends-2020.pdf

Wilk A. 2019. Teaching ai, ethics, law and policy, version 5. [accessed 4 September 2024]. https://arxiv.org/abs/1904.12470

Winfield A, Jirotka M. 2018. Ethical governance is essential to building trust in robotics and artifical intelligence. Philos Transact R Soc A. 376:20180085. https://doi.org/10.1098/rsta.2018.0085

Yamamoto I. 2019, Mar. The impact of AI and information technologies on worker stress. Centre for Economic Policy Research. [accessed 23 February 2024]. https://cepr.org/voxeu/columns/impact-ai-and-information-technologies-worker-stress

Ye Y, You H, Du J. 2023. Improved trust in human-robot collaboration with chatgpt. IEEE Access. 11:55748–55754. https://doi.org/10.1109/access.2023.3282111

Yilma K. 2024. From principles to process: the principalist approach to AI ethics and lessons from the internet bills of rights. Addis Ababa School of Law working paper series no. 02/2024. [accessed 4 September 2024]. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4814437