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Navigating the Ethical Terrain of the Fourth Industrial Revolution: A Moral Theoretical Analysis

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Abstract

The unprecedented and transformative nature of the Fourth Industrial Revolution (4IR)presents several ethical challenges. This paper examines suchfour challenges in the domains of employment, environment, accessibility, and privacy through three key moral theories: utilitarian, deontological, and virtue ethics. Based on a dialectical method,the analysis suggests that the limitations of the theories may lead to immoral and unethical actions or outcomes in 4IR, and therefore, there is a need to synthesize the three theories in navigating 4IR and its innovations ethically and morally. Through the integration of the theories, the paper provides normative suggestions to consider human rights, long-term consequences of actions, and the inclusion of the principles of equity, inclusivity, and learning in determining the morality of 4IR's innovations and their application. This paper is expected to contribute to the international and ethical governance of 4IR technologies.

Keywords:4IR, Utilitarianism, Deontology, Virtue, Sustainability, Surveillance.

Introduction

The term Fourth Industrial Revolution (4IR), popularized bySchwab (2016) and theWorld Economic Forum(2016), refers to a phenomenon where the profound integration of artificial intelligence (AI), robotics, automation, and advanced ICT is likely to radicallytransform the conventional way of living, which is unprecedented, rapid and sometimes unpredictable. According to Schwab (2016), technologies of 4IR such as AI, Robotics, Quantum Computing, IoT (Internet of Things), Blockchain, 3D printing, and genetic engineering are going to obscure the lines between physical, digital, and biological spheres. Such transformation, however, comes with unique opportunities and challenges. For instance, Robotics and AI can assist human beings in their day-to-day activities. Still,when these technologies outsmart humans, itcan either result in unlimited leisure for human beings or

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make them vulnerable to survival, creating an ethical dilemma for the use and development of such technologies. Due to the obscuration of physical, digital, and biological spheres with the use of 4IR technologies, several ethical issues occur in the social and economic lives, which require both practical and theoretical exploration using the established moral theories that explain the morality of actions.

Although several studies (such as Berrah et al., 2021; Eich et al., 2023; Hooker & Kim, 2019; Mpofu & Nicolaides, 2019; Peckham, 2021) investigated the overt ethical issues associated with 4IR and the use of its technologies, the analysis from a moral theoretical standpoint remains scarce. Moreover, due to the rapidly changing and unpredictable nature of 4IR, it is also essential to examine how the major moral theories perform in explaining the phenomenon. Therefore, this review paper examines four moral issues concerning environment, employment, accessibility, and privacy associated with 4IR and its technologies through the framework of utilitarian, deontological, and virtue ethics from a dialectical lens and proposes a normative moral standard for navigating 4IR that is ethical and can be beneficial for global governance of 4IR technologies.4IR and its technologies, indeed, however, present numerous ethical issues beyond these four. Still, the issues for this paper have been selected due to their immediate and already evident nature that concerns the majority of the global population.

The paper is divided into five major sections. The first one details the methods employed in this review paper, and the second sectionprovides a brief account of the moral theories. The next section analyzes the selected ethical issues through the moral theories, and in the later sections, the theories are critically evaluated and synthesizedto providea normative guideline for an ethical and moral 4IR,followed by a conclusion.

Methods

This review paper employs the moral theories, i.e., utilitarianism, deontology, and virtue ethics as the analytical framework to analyze the core ethical issues associated with 4IR and the analytical method is guided through the Hegelian dialectics. In the dialectical method by Hegel, the coaction and contradiction among opposing propositions, namely, the thesis and antithesis, are synthesized into a higher level of truth(Maybee, 2020; Pascual-Leone, 2014). Following the dialectical method, this paper considers each ethical concern as the thesis, constructed based on the review of key academic literature on the impact of 4IR. And then the analysis of the thesis through the analytical framework leads to the antitheses. Later, the antitheses for each issue are synthesized into propositions to navigate the 4IR and its technologies ethically and morally. Similar methods have been previously used in business ethics and energy transitions literature. For

instance,Victor & Stephens (1994)suggested the unification of normative philosophy with descriptive social science in the field of business ethics for improved ethical behavior in business. Moreover,Bethem et al. (2020) integrated utilitarian, deontology, virtue, and native American ethics to develop a moral framework for better energy decisions and transitions.

Moral Theories: A Brief

Each moral theory proposesa different justification regarding the morality of an action. Considering the limited scope of the paper, the three most common schools of moral theories have been selected as discussed below, and they have been chosen in their most basic form. The theories include utilitarian ethics by Jeremy Bentham and John Stuart Mill, deontological ethics by Immanuel Kant, and Virtue Ethics by Aristotle.

Utilitarianism

Utilitarian ethics or classical utilitarianism determines the morality of an action based on the result it produces. According to this moral theory, an action that maximizes the overall value or happiness for the majority is moral(Mulgan, 2014). Therefore, in other words, this theory promotes collective well-being(Eggleston, 2022). The early thinkers of this moral theory, such as Jeremy Bentham and John Stuart Mill, were influenced by the need for legal and social reform to increase overall happiness and eliminate unhappiness and misery derived from laws with a lack of utility(Driver, 2022). Similarly, in the context of 4IR, the application of utilitarian ethics in the development of 4IR technologies can lead to widely advantageous inventions and the development of national and international policies that may maximize collective happiness. However, utilitarianism's emphasis on the consequence of actions for maximum happiness has the potential to lead to immoral actions(Eggleston, 2022).

Deontology

Kantian Deontological ethics assess the morality of an action through the intention behind it.Since the focus of the action is on the intention, this moral theory is not concerned with the consequence of the action, instead it is interested in what comes before the action(Alexander & Moore, 2021). Per this theory, these intentions before action should follow some rules or maxims that Kant termed the 'categorical imperatives.' And the categorical imperatives decide whether the action is moral or immoral. The categorical imperative suggests that the intentions should be binding and universal, which means the rules or maxims must be followed by all and will be applied to all people. For example, principles such as 'causing no harm to others' or'equal treatment for all' andall must potentially agree upon and follow the categorical imperatives to be morally permissible. Otherwise, it will be morally impermissible(White, 2009).

Moreover, deontological ethics, based upon the categorical imperativesets the universal moral obligation to respect the humanity of

others, suggesting that people should not be treated as a means to an end but as an end in themselves(O'Neill, 2016). Thus, this theory obliges considering a person as a person. Application of this theory to 4IR can thus help to address structural injustice and human rights issues in 4IR while ensuring social justice. Nevertheless, the exclusive focus on the intention by this moral theory can lead to immoral consequences. Also, the rigidity of the universal obligation can be challenging in novel and unprecedented circumstances like 4IR, where breaking the rule might lead to positive outcomes(Alexander & Moore, 2021; O'Neill, 2016).

Virtue

Virtue ethics is primarily based on the works of Aristotle, which advocates doing the right thing for the right reason in an appropriate way that leads to a good life for the person doing it(Annas, 2007; Van Hooft, 2014). Specifically, according to this moral theory, a virtuous agent not only possesses but exercises virtues (such as honesty, kindness, generosity, courage, and so on), which help the agent achieve 'eudaimoniā' or happiness and fulfillment(Van Hooft, 2014). The exercise of such virtues is driven by reason, which is learned through practice, education, or role models(Annas, 2007). Therefore, virtue ethics deals with the question of what kind of person should someone be(Hursthouse, 2016).

Furthermore, the concept of 'doctrine of means' within this moral theory drives the reasonable exercise of virtues, which translates as the balanced response to a certain situation between ' a vice of excess and defect'(Frede, 2015). Specifically, Aristotle(in Frede, 2015) explains the 'vice of excess and defect' as 'rashness' and 'cowardice' and they are balanced by 'courage', which represents virtue. Therefore, unlike Kantian deontology, virtue ethics does not promote the rigidity of rules and regulations at a universal scale; instead, it promotes context sensitivity. The application of virtue ethics will likely help individuals to be more ethical and virtuous in navigating the challenges posed by 4IR. Nevertheless, due to the 'vice of excess and defect,' this moral theory lacks clear guidelines as the balancing act can be perplexing, and virtue may seem elitist since reasoning greatly depends upon prior education and upbringing(Annas, 2007; Athanassoulis, 2012). Moreover, virtue ethics is criticized for being too agent-centered due to its focus on personal reasoning and happiness(Hursthouse, 2016).

Key Ethical Concerns in 4IR: Analyzed through Moral Theories

4IR and its technologiesconspicuously cause ethical challenges in the areas of employment and well-being, environmental degradation and sustainability, access to technologies, and privacy and surveillance. The following section analyzes them following a dialectical method, with the help of the moral theories discussed in the previous section.

Unemployment and Wellbeing

The possible unemployment and displacement of workers in 4IR and their well-being present a pressing ethical dilemma.Peters & Jandrić (2019)convey that a significant number of workers around the world will be unemployed due to automation, and fewer jobs will be available for those who will enter the workforce in the future.Bajpai & Biberman (2019), specifically suggest thatmid-level jobs that require low skills and follow a repetitive pattern will be vulnerable and likely obliterated due to automation during 4IR.Osborne & MacCarthy (2014 in Peters & Jandrić, 2019) further imply that the wage rate for the available jobs will plummet. Consequently,such significant jobloss will likely provoke economic inequality, especially in developing countries(Zahid, 2020). Alternatively, alongside the displacement effect,Acemoglu & Restrepo (2018) argued about a reinstatement effect in the job sector due to technological advancement, which suggests generating new employment opportunities due to automation.Phiromswad et al. (2022) have also rejected the fear of unemployment due to automation as 'overrated' since it creates new jobs that accelerate economic growth. Brynjolfsson et al. (2019 inSchulte-Althoff, 2023) alsoaffirmed that automation enhances economies of scale that boost overall productivity and growth.

In this case, from a utilitarian perspective, the loss of a job in 4IR is considered ethical since a specific group is impacted by unemployment, but at the same time, more and better jobs are created, replacing the old ones, and growth and productivity are increasing. In a global capitalist system, from a normative view, improved growth is supposed to impact more people than a few groups of unemployed, and alongside, more significant economies of scale provide more consumer choice and liberty to the people, which will likely enhance their overall productivity and lead to greater overall happiness (Matsuyama, 2002). Consequently, greater happiness outweighs the collective pain of unemployment. On the other hand, the maxim of deontological ethics to not harm others can see the intention to develop technology to increase production by cutting manual labor and causing unemployment as unethical and thus rejecting the possibility of technological innovation without even considering the consequence of the new jobs and opportunities that may rehabilitate the displaced workers. In the case of technological unemployment, virtue ethics finds it challenging to assess its morality due to the theory's focus on personal happiness. However, it can balance growth and poverty through the virtue of charity and learning, such as safety nets for the temporarily unemployed, preserving some traditional jobs, andacquiring new skills for future demands. Nevertheless, charity cannot lead to fulfillment, but learning can.

Environmental Degradation and Sustainability

The potential of 4IR technologies in the transition to a sustainable environment and the need for more energy for its continuous development and functioning at the cost of the environment creates an ethical problem.

For instance, theWorld Economic Forum (2017)reports that 4IR technologies promote renewable, decentralized energy generation, including rooftop solar, city heat networks, and peer-to-peer energy-sharing systems. On the flip side,Lucivero (2020) suggests that the requirement of Big Data for ICT technology relies heavily upon data centers and cloud computing that requires high consumption of non-renewable energy, significantly contributing to CO2 emissions and waste production.Ganesan et al. (2020) postulate that 4IR technologies, such as IoT, that lie at the center of smart and sustainable systems, require cloud-based data centers to process the massive data they harness, and these cloud computing data centers act as a 'blackhole' of energy consumption as they emit 23% carbon in the ICT sector.

In this case, utilitarianism is likely to declare that environmental degradation for technological development to be morally right since the overall benefit from the technology is likely to surpass the ecological cost. Moreover, the continuous development of the technology is also expected to result in the development of mechanisms for the technologies to function. For example,scientists are employing 4IR technologies to optimize performance and reduce energy consumption through advanced hardware and software developmentsto make cloud computing green and sustainable (Raza et al., 2024).However, failing to do so for more profit as per the utilitarian principleand relinquishing the expected ecological consequence can lead to detrimental environmental impacts for future generations. In the light of deontological ethics, the rigidity of the universally accepted maxim of causing no harm to the environment can, however, altogether prevent the progress of technological development and functioning as unethical, even though there remains a possibility to reduce the environmental burden through continuous development. Virtue ethics, however, will consider the case as moral by balancing between environmental degradation and technological advancement that ensure long-term benefit and intergenerational justice since considering the context, innovation can neither be totally prohibited nor should it be unregulated. Nevertheless, excessive agent centrism prevents virtue ethics from advocating collective action for collective happiness.

Digital Divide and Technological Access

The challenges of ensuring equal access to 4IR technologies pose some ethical dilemmas due to the existing and widening digital divide, within and across countries. Specifically, the digital divide refers to the gap between people with access to digital technologies and those with poor or no access to them and such a phenomenon is further exacerbated by socioeconomic and spatial statuses(Jere et al., 2021). Research byvan Deursen & Mossberger (2018) states that the digital divide restricts people from achieving the skills that enable them to use 4IR technologies. Therefore, these technologies remain preserved within a specific privileged group that

cannot ensure the perceived benefit of these technologies.Lythreatis et al. (2022) has similarly argued the emergence of a new phenomenon in the digital divide named ‘data inequality,’ where people cannot access the massive data being harnessed every day to analyze, interpret, and guide their decisions.Taylor (2017) also suggested that the digital divide leads to ‘data injustice,’ which restricts the visibility of those with poor or no access to digital technologies in data-driven decisions.Hilbert (2016), on the other hand,suggests that the privileged groups with access to digital technologies, especially in the developed countries, are overrepresented in the data. Consequently, different groups are discriminately impacted by data and its possibilities.

In this case, utilitarianism is likely to consider the lack of access as unethical as it does not ensure collective well-being and would promote investment and development of technologies as it will likely bring high returns, and the benefits of which are likely to be distributed equally. Moreover, through continuous technological development, technology will eventually be affordable and accessible to all, including the developed countries. However, meanwhile, with the continuous development of 4IR technologies, the existing divide is likely to be widened because emerging economies often lag in catching up with the adoption of new technologies with the speed of its diffusion due to economic, infrastructural, institutional and human resource related limitations, resulting in an extensive digital divide(Hilbert, 2016; Jiang et al., 2018). Moreover, the deontological universal maxim of ‘treating everyone equally’ will consider the inaccessibility to technology as immoral. And on the other hand, based on the principle of ‘elimination of inequality,’deontology will advocate equal distribution of 4IR technologies. However, this moral theory will fail to address the deep-rooted inequality due to the existing and likely increasing digital divide. In this circumstance, virtue ethics can advocate moral action to reduce the gap by balancing equality and discrimination and ensuring equity that distributes resources based on need, leading to more fair outcomes. However, the agent-centered focus of this moral theory may restrict or discourage structural change to address the digital divide, data inequality, and injustice.

Privacy and Surveillance

The continuous collection of data using 4IR technologies presents anethical challenge as it can both increase safety and security while potentially breaching it. The passive and constant collection of data has blurred the boundary of informed consent and in what way personal data is being used creates concern for the breach of personal freedom(Quach et al., 2022). To be specific, continuous collection of data through cookies(Hilts & Parsons, 2015), mobile apps(Zohar, 2023), and social media activity(Pan & Ding, 2018) can manipulate the political and consumer behavior of the users.Zuboff (2019) have termed such phenomenon as surveillance

capitalism, where, unlike traditional capitalism,data of human experience and behaviour are commodified for market exchange by big corporations. Also, the infamous case of Cambridge Analytica's use of social media data for political profiling and advertisement demonstrates the crisis of informed consent in 4IR(Isaak & Hanna, 2018). However, continuous and passive data collection has also enhanced the surveillance capacity that can prevent conflict and crimes or the outbreak of specific diseases through early detection(Donnay et al., 2018; Kilgallon et al., 2022; Mhlanga, 2022).

In this dilemma, utilitarian ethics will consider surveillance as moral since its consequence is ensuring collective well-being by preventing conflicts and diseases at the seemingly harmless cost of privacy. Deontology, however, follows the universal maxim of 'protection of individual privacy' and ‘treat everyone equally’ and is likely to consider continuous data collection unethical. However, such rigidity also enhances the possibility of traditional as well as new forms of crimes and conflicts by those who does not adhere to deontology. In this case, virtue ethics can solve the dilemma and make it moral by handling the data with integrity, honesty, and care. Moreover, such virtues can guarantee informed consent and the right to hold and control private data, which leads to personal freedom. However, in line with the agent-centric criticism of virtue ethics, individuals might not be interested in protecting collective data and freedom, failing to address the broader systematic surveillance.

Synthesis and Propositions for an Ethical 4IR

From the dialectical analysis of the major ethical dilemmas of 4IR, it is apparent that each theory produces different explanations of the morality of actions. These explanations are either often incomplete due to the limitations of the theories themselves or raise skepticism about their application. From the analysis, it is evident that in most cases, utilitarianism's need to achieve collective well-being and happiness and its lack of forward-looking character justifies technological unemployment, environmental degradation, and mass surveillance as ethical. Such justification can result in actions such as social unrest, political oppression, or unsustainable environmental practices. Such limitations signal the inclusion of long-term focus into the consequences of utilitarianism to determine the morality of an action in the ethical challenges posed by 4IR.

On the other hand, the rigidity of the categorical imperatives of deontological ethics tends to denounce many actionsasunethical, restricting even the possibility of identifying better ways of doing things that may lead to peace and harmony. However, the unfolding of 4IR and its technologies are unprecedented, and there must be room for risk and experimentation, which is predominantly averted by this moral theory due to its strict adherence to universally acceptable principles. However, in a quickly changing and complicated world, with the changing meaning of right and

wrong, such rigidity, if seen exclusively from the deontological ethical perspective, can lead to unethical actions and consequences. Thus, the maxims deserve reconsideration in analyzing the morality of actions in anevolving and complex world.

Apart from the major limitation of the result and rule-based ethics, i.e., utilitarianism and deontology, virtue ethics performs comparatively superior due to its balancing act as per the doctrine of means that is required in maneuvering the moral dilemmas of 4IR, belonging to a changing and complex world. Peckham's (2021)study navigating the ethical implications of 4IR also exclusively suggests a virtuous approach to deal with its ethical issues. The limitation of the moral theory to the agent's self to achieving self-fulfilment, however, restricts itself from perfectly interpreting the morality of actions in 4IR. The application of the virtues in the collective sense can, therefore, solve the limitation of this moral theory in determining the morality of 4IR dilemmas. Specifically, the shift from the agent's centrism to a collective focus for collective happiness can, therefore, advocate for technological advancement but not at the cost of the environment, address the root causes of a digital divide, protect privacy but not at the risk of security and promote the virtue of learning to survive in the changing world.

Interestingly, the suggestion of collective virtues offers virtue ethics a deontological essence where the decision through the balancing act becomes somewhat universally binding. Again, the recommendation for reconsidering the maxims gives deontology a character of virtue ethics through the balancing act of doctrine of means. Therefore, the limitations of the theories and their failure to interpret the morality of 4IR actions by themselves can be minimized by synthesizing them to determine ethical actions for 4IR. Through synthesis and addressing the limitations of the three major moral theories, three normative propositions can be integrated into the new moral paradigm to navigate ethical 4IR.

First, long-term and intergenerational consequences must be considered in the development and functioning of 4IR technologies. This will ensure the development of sustainable technology while causing no harm to the environment.To be specific, a technology of the future will only be allowed to be used after it is proven to cause no harm to the environment and humanity, instead of continuing to harm the environment and people and concurrently finding a technological solution to the ongoing and future damage. The sustainable development goals(United Nations, 2016)promote a similar principle, primarily through goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 11 (Sustainable Cities and Communities), and 12 (Responsible Consumption and Production). Thus, in further advancement of this proposition, the UN SDGs can be an excellent primary navigator.

Second, the dissemination of 4IR technology should be based on the collective virtues of equity, inclusivity, and learning. Specifically, continuous and updated learning opportunities should be available through adequate infrastructural arrangements for all according to their learning capacity. This will minimise the digital divide, facilitate the acquisition of skills to survive in 4IR,and facilitate technological development in a manner that ensures social justice.Anakpo & Kollamparambil (2022) andFilippi et al. (2023) have also emphasized the availability of training infrastructure and argued that training can help escape technological unemployment and enhance employability. Moreover, along the lines of equity and inclusivity,Peters & Jandrić (2019) have also advocated for job preservation and social welfare policies such as basic income, which provides a safety net for the vulnerable and guarantees social justice.

Third, fundamental human rights and their changing concerns must be considered when developing and applying 4IR technology. The inclusion of this maxim will minimize the digital divide, reduce inequality, restore privacy, and prevent unemployment. These moral principles will establish the control of human agency over the independent development of technology for a better world. Therefore, integrating these moral principles in global governance and international policymaking frameworks can lead to an equal future and lead a just transition.Morgan (2019) has similarly argued that the dystopian perception of 4IR is not justifiable since humans can shape the future through the control of technology, and for such initiatives, solid governance frameworks with the integration of such concerns are pivotal.

However, these propositions are normative to the core and based on the causal and theoretical analysis presented throughout the paper and so they are not immune to practical challenges, and they can re produce further ethical issues. For instance, governments operating within a global capitalist system might not be interested in the first proposition of safe technology for several political and economic reasons, discussing which is beyond the capacity of this current paper. Also, adhering to the proposition might call for a reform of the current economic system, which might seem a threat to the ongoing hegemony. Furthermore, the second proposition can lead to an army of new forms of technological wage earners or an overcrowded service sector due to the obliteration of traditional jobs(Schlogl & Sumner, 2020), which might not improve the existing inequality and enhance the dominance of the technologically advanced ones over the technological laggards. Additionally, the skepticism of the individual national governments in sustainable and ethical 4IR can lead to problems for global governance. Previous studies(Murphy, 2000; Rodrik, 2020) have argued that global powers do not want progressive change, and when policies are made in the national interest without concern for overall global interest and cooperation,

it leads to the failure of global governance. Future studies can investigate these issues with both a theoretical and empirical focus.

Conclusion

This review paper attempted to explain some significant ethical concerns of 4IR using utilitarianism, deontology, and virtue ethics and evaluate them in a rapidly changing and unprecedented context. The analysis following Hegelian dialectics suggested that the theories alone often struggle to explain the morality of actions in issues concerning environment, employment, accessibility, and privacy associated with 4IR and its technologies, leading to immoral consequences. Instead, their synthesis and integration along with a shift from the short-term focus can better explain the morality of the actions, which can be translated into a set of normative actions that can help navigate the challenges of 4IR in the days ahead. The analysis presented in this paper is expected to contribute to better global governance of technological transformation and the construction of a new moral paradigm for the changing world, based on the classical moral theories.

References

Acemoglu, D., & Restrepo, P. (2018). *Artificial Intelligence, Automation and Work* (Working Paper 24196). National Bureau of Economic Research. https://doi.org/10.3386/w24196

Alexander, L., & Moore, M. (2021). Deontological Ethics. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2021). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2021/entries/ethics-deontological/

Anakpo, G., &Kollamparambil, U. (2022). Effect of automation on unemployment: The case of Southern Africa. *Development Southern Africa*, *39*(4), 516–527. https://doi.org/10.1080/0376835X.2021.1978931

Annas, J. (2007). Virtue Ethics. In D. Copp (Ed.), *The Oxford Handbook of Ethical Theory* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195325911.003.0019

Athanassoulis, N. (2012). *Virtue Ethics*. Bloomsbury Publishing.

Bajpai, N., & Biberman, J. (2019). *The Future of Work in India: Adapting to the Fourth Industrial Revolution* (Working Paper 11). ICT India Working Paper. https://www.econstor.eu/handle/10419/249800

Berrah, L., Cliville, V., Trentesaux, D., & Chapel, C. (2021). Industrial Performance: An Evolution Incorporating Ethics in the Context of Industry 4.0. *Sustainability*, *13*(16), Article 16. https://doi.org/10.3390/su13169209

Bethem, J., Frigo, G., Biswas, S., DesRoches, C. T., & Pasqualetti, M. (2020). Energy decisions within an applied ethics framework: An analysis of five recent controversies. *Energy, Sustainability and Society*, *10*(1), 29. https://doi.org/10.1186/s13705-020-00261-6

Donnay, K., Dunford, E. T., McGrath, E. C., Backer, D., & Cunningham, D. E. (2018). Integrating Conflict Event Data. *Journal of Conflict Resolution*. https://doi.org/10.1177/0022002718777050

Driver, J. (2022). The History of Utilitarianism. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Winter 2022). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2022/entries/utilitarianism-history/

Eggleston, B. (2022). *Utilitarianism*. Obo. https://www.oxfordbibliographies.com/display/document/obo-9780195396577/obo-9780195396577-0431.xml

Eich, A., Klichowicz, A., &Bocklisch, F. (2023). How automation level influences moral decisions of humans collaborating with industrial robots in different scenarios. *Frontiers in Psychology*, *14*, 1107306. https://doi.org/10.3389/fpsyg.2023.1107306

Filippi, E., Bannò, M., & Trento, S. (2023). Automation technologies and their impact on employment: A review, synthesis and future research agenda. *Technological Forecasting and Social Change*, *191*, 122448. https://doi.org/10.1016/j.techfore.2023.122448

Frede, D. (2015). Aristotle's Virtue Ethics. In *The Routledge Companion to Virtue Ethics*. Routledge.

Ganesan, M., Kor, A.-L., Pattinson, C., & Rondeau, E. (2020). Green Cloud Software Engineering for Big Data Processing. *Sustainability*, *12*(21), 9255. https://doi.org/10.3390/su12219255

Hilbert, M. (2016). Big Data for Development: A Review of Promises and Challenges. *Development Policy Review*, *34*(1), 135–174. https://doi.org/10.1111/dpr.12142

Hilts, A., & Parsons, C. A. (2015). *Half Baked: The Opportunity to Secure Cookie-Based Identifiers from Passive Surveillance* (SSRN Scholarly Paper 2640610). https://doi.org/10.2139/ssrn.2640610

Hooker, J., & Kim, T. W. (2019). Ethical Implications of the Fourth Industrial Revolution for Business and Society. In *Business Ethics* (Vol. 3, pp. 35–63). Emerald Publishing Limited. https://doi.org/10.1108/S2514-175920190000003002

Hursthouse, R. (2016). On Virtue Ethics. In *Applied Ethics* (6th ed.). Routledge.

Isaak, J., & Hanna, M. J. (2018). User Data Privacy: Facebook, Cambridge Analytica, and Privacy Protection. *Computer*, *51*(8), 56–59. Computer. https://doi.org/10.1109/MC.2018.3191268

Jere, N. R., Jere, T. L., & Sibanyoni, E. (2021). Fourth Industrial Revolution Meaning to Disadvantaged Communities. In *The Palgrave Handbook of Global Social Problems* (pp. 1–19). Springer International Publishing. https://doi.org/10.1007/978-3-030-68127-2_438-1

Jiang, H., Zhao, S., Yuan, Y., Zhang, L., Duan, L., & Zhang, W. (2018). The coupling relationship between standard development and technology advancement: A game theoretical perspective. *Technological Forecasting and Social Change*, *135*, 169–177. https://doi.org/10.1016/j.techfore.2017.11.018

Kilgallon, J. L., Tewarie, I. A., Broekman, M. L. D., Rana, A., & Smith, T. R. (2022). Passive Data Use for Ethical Digital Public Health Surveillance in a Postpandemic World. *Journal of Medical Internet Research*, *24*(2), e30524. https://doi.org/10.2196/30524

Lucivero, F. (2020). Big Data, Big Waste? A Reflection on the Environmental Sustainability of Big Data Initiatives. *Science and Engineering Ethics*, *26*(2), 1009–1030. https://doi.org/10.1007/s11948-019-00171-7

Lythreatis, S., Singh, S. K., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change*, *175*, 121359. https://doi.org/10.1016/j.techfore.2021.121359

Matsuyama, K. (2002). The Rise of Mass Consumption Societies. *Journal of Political Economy*, *110*(5), 1035–1070. https://doi.org/10.1086/341873

Maybee, J. E. (2020). Hegel's Dialectics. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2020). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2020/entries/hegel-dialectics/

Mhlanga, D. (2022). The Role of Artificial Intelligence and Machine Learning Amid the COVID-19 Pandemic: What Lessons Are We Learning on 4IR and the Sustainable Development Goals. *International Journal of Environmental Research and Public Health*, *19*(3), 1879. https://doi.org/10.3390/ijerph19031879

Morgan, J. (2019). Will we work in twenty-first century capitalism? A critique of the fourth industrial revolution literature. *Economy and Society*, *48*(3), 371–398. https://doi.org/10.1080/03085147.2019.1620027

Mpofu, R., & Nicolaides, A. (2019). Frankenstein and the Fourth Industrial Revolution (4IR): Ethics and Human Rights Considerations. *Tourism and Leisure*, *8*.

Mulgan, T. (2014). *Understanding Utilitarianism*. Routledge. https://doi.org/10.4324/9781315711928

Murphy, C. N. (2000). Global Governance: Poorly done and Poorly Understood. *International Affairs*, *76*(4), 789–803. https://doi.org/10.1111/1468-2346.00165

O'Neill, O. (2016). A Simplified Account of Kant's Ethics. In *Applied Ethics* (6th ed.). Routledge.

Pan, S., & Ding, T. (2018). *Automatically Infer Human Traits and Behavior from Social Media Data*. http://hdl.handle.net/11603/10728

Pascual-Leone, J. (2014). Dialectics. In T. Teo (Ed.), *Encyclopedia of Critical Psychology* (pp. 421–428). Springer. https://doi.org/10.1007/978-1-4614-5583-7_338

Peckham, J. B. (2021). The ethical implications of 4IR. *Journal of Ethics in Entrepreneurship and Technology*, *1*(1), 30–42. https://doi.org/10.1108/JEET-04-2021-0016

Peters, M. A., & Jandrić, P. (2019). Education and Technological Unemployment in the Fourth Industrial Revolution. In G. Redding, A. Drew, & S. Crump (Eds.), *The Oxford Handbook of Higher Education Systems and University Management* (1st ed., pp. 394–413). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198822905.013.27

Phiromswad, P., Srivannaboon, S., &Sarajoti, P. (2022). The interaction effects of automation and population aging on labor market. *PLOS ONE*, *17*(2), e0263704. https://doi.org/10.1371/journal.pone.0263704

Quach, S., Thaichon, P., Martin, K. D., Weaven, S., & Palmatier, R. W. (2022). Digital technologies: Tensions in privacy and data. *Journal of the Academy of Marketing Science*, *50*(6), 1299–1323. https://doi.org/10.1007/s11747-022-00845-y

Raza, M., Ks, S., K, S., & Mohamad, A. (2024). Carbon footprint reduction in cloud computing: Best practices and emerging trends. *International Journal of Cloud Computing and Database Management*, *5*(1), 25–33. https://doi.org/10.33545/27075907.2024.v5.i1a.58

Rodrik, D. (2020). Putting Global Governance in Its Place. *The World Bank Research Observer*, *35*(1), 1–18. https://doi.org/10.1093/wbro/lkz008

Schlogl, L., & Sumner, A. (2020). *Disrupted Development and the Future of Inequality in the Age of Automation*. Springer International Publishing. https://doi.org/10.1007/978-3-030-30131-6

Schulte-Althoff, M. (2023). *What's to Automate? A Task Analysis of AI-enabled Start-ups*. https://hdl.handle.net/10125/102831

Schwab, K. (2016). *The fourth industrial revolution* (First U.S. edition). Crown Business.

Taylor, L. (2017). What is data justice? The case for connecting digital rights and freedoms globally. *Big Data & Society*, *4*(2), 2053951717736335. https://doi.org/10.1177/2053951717736335

United Nations. (2016). *THE 17 GOALS | Sustainable Development*. https://sdgs.un.org/goals

van Deursen, A. J. A. M., & Mossberger, K. (2018). Any Thing for Anyone? A New Digital Divide in Internet-of-Things Skills. *Policy & Internet*, *10*(2), 122–140. https://doi.org/10.1002/poi3.171

Van Hooft, S. (2014). *Understanding Virtue Ethics* (1st ed.). Routledge. https://doi.org/10.4324/9781315712130

Victor, B., & Stephens, C. U. (1994). Business Ethics: A Synthesis of Normative Philosophy and Empirical Social Science. *Business Ethics Quarterly*, *4*(2), 145–155. https://doi.org/10.2307/3857486

White, M. D. (2009). In Defense of Deontology and Kant: A Reply to van Staveren. *Review of Political Economy*, *21*(2), 299–307. https://doi.org/10.1080/09538250902834103

World Economic Forum. (2016, January 14). *The Fourth Industrial Revolution: What it means and how to respond*. World Economic Forum. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

World Economic Forum. (2017). *Harnessing the Fourth Industrial Revolution for Sustainable Emerging Cities* (Fourth Industrial Revolution for the Earth Series). https://t.ly/R57ZF

Zahid, A. (2020). *Income Inequality in Bangladesh: Problems and Prospects for the Coming Fourth Industrial Revolution* [Masters Capstone Project]. The University of Sydney.

Zohar, N. (2023). Monitoring Passive Wireless Devices. *International Journal of Wireless Information Networks*, *30*(2), 190–197. https://doi.org/10.1007/s10776-023-00594-x

Zuboff, S. (2019). Surveillance Capitalism and the Challenge of Collective Action. *New Labor Forum*, *28*(1), 10–29. https://doi.org/10.1177/1095796018819461