

THE ROLE OF ARTIFICIAL INTELLIGENCE AND AUTOMATION IN SHAPING LABOR MARKETS

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Abstract: *This article provides a comprehensive exploration of the role of Artificial Intelligence and automation in shaping labor markets. Through an interdisciplinary lens, the paper examines technological disruptions, economic implications, societal challenges, future perspectives, and environmental considerations. It highlights the transformative impact of AI and automation on industries and job markets, analyzing the potential for growth alongside the risks of inequality and job displacement. The paper also delves into ethical and social aspects, emphasizing the need for collaboration across sectors, innovative policies, and continuous learning to harness the benefits of these technologies while addressing their multifaceted challenges.*

Keywords: *Artificial Intelligence, Automation, Labor Markets, Skill Gap.*

JEL: J24, O33; O38.

1. Introduction

As we enter 2023, labor-market transformations are no longer mere predictions; they are our present reality. Driven by the coming of age of generative artificial intelligence (AI), these shifts are further intensified by wide-ranging economic, health, and geopolitical factors. High-income countries are experiencing tight labour markets, while low- and lower-middle-income nations grapple with unemployment rates that remain elevated in the wake of the COVID-19 pandemic. The divergence is also evident at an individual level, with workers possessing only basic education and women facing reduced employment opportunities. Alongside declining real wages due to a persistent cost-of-living crisis, concerns about the quality of work and changing worker expectations are emerging as prominent global issues. These trends underscore the complex relationship between technology, economy, and society. The rapid progression of AI and automation technologies holds the promise of transformative growth and innovation but also raises critical challenges. Job displacement, widening

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inequality, and ethical considerations are among the complexities that require thoughtful examination.

Artificial Intelligence and automation technologies have become central to the modern world, with their applications spanning diverse fields, from manufacturing to healthcare, finance to transportation (Brynjolfsson & McAfee, *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*, 2014). Rapid advancements in machine learning, robotics, and intelligent systems have ushered in what many term the "Fourth Industrial Revolution" (Schwab, 2016), characterized by the fusion of digital, physical, and biological technologies. This transformation has far-reaching implications, reshaping economies, industries, and individual lives. Particularly, the intersection of AI and automation with labour markets has ignited robust debates among economists, policymakers, and business leaders (Acemoglu & Restrepo, 2018). As automation replaces various manual and repetitive tasks (Frey & Osborne, 2017), and AI-driven systems augment human decision-making (Davenport & Kirby, 2016), the traditional landscape of employment is being fundamentally altered.

While there is consensus that these technologies are revolutionary, the evaluation of their impact on labour markets yields a more complex picture. Optimists see vast potential for increased efficiency, productivity, and the creation of new types of jobs (McKinsey & Company, 2017). Pessimists, however, warn of significant job displacement, widening inequality, and societal disruption (Bessen, 2018).

This article seeks to explore the multifaceted role of AI and automation in shaping labour markets, delving into technological disruptions, economic implications, societal challenges, and future perspectives. By examining empirical evidence, theoretical insights, and real-world examples, we aim to provide a comprehensive understanding of this critical and timely issue.

2. Technological Disruptions

Job automation enabled by advances in robotics, computer vision, and machine learning, has led to the replacement of various manual, repetitive, and routine tasks with machines. Historically, automation has been confined to industries like manufacturing, but it now permeates sectors ranging from retail to transportation (Autor, 2015).

The benefits of automation include increased efficiency, productivity, and safety, particularly in hazardous or monotonous jobs. However, these advancements pose significant challenges concerning job displacement, particularly for low-skilled workers (Arntz & Gregory, 2016). Economists like (Acemoglu & Restrepo, 2018) highlight a negative correlation between

automation and employment, especially in local labour markets heavily reliant on routine jobs.

A study by McKinsey Global Institute estimates that by 2030, activities that account for up to 30 percent of hours currently worked across the US economy could be automated. Generative AI appears to be augmenting the working methods of professionals in STEM (Science, technology, engineering, and mathematics), creative, business, and legal fields, rather than leading to a substantial reduction in employment within these areas. Instead, the most pronounced impacts of automation are likely to be felt in other job categories. Sectors such as office support, customer service, and food service may continue to experience a decline in employment. As workers exit professions that are contracting, the economic focus could shift toward higher-wage positions. Those in lower-wage roles may face up to 14 times greater likelihood of needing to switch occupations compared to individuals in the highest-wage positions, and acquiring new skills will likely be essential for a successful transition. Furthermore, women might face a 1.5 times greater need to move into new professions compared to men. (Ellingrud, Sanghvi, & Dandona, 2023).

(World Economic Forum, 2023) report suggests that the boundary between human and machine labour has shifted, but not as rapidly as many expected. Businesses are implementing automation more gradually, with current estimates indicating that machines perform 34% of all business-related tasks, leaving humans to handle the remaining 66%. This reflects a minor 1% growth in automation since the 2020. Contrary to the predictions from the 2020 survey, where almost half (47%) of business tasks were expected to be automated within five years, today's projections have been revised downwards. Now, businesses anticipate that 42% of tasks will be automated by 2027. The range of expected automation spans from 35% for reasoning and decision-making tasks to 65% for information and data processing. Even though there's been a decline in the expectation for machines to displace physical and manual work, the outlook for automation in areas such as reasoning, communicating, and coordinating – where humans typically have an edge – has increased. Artificial intelligence, a significant factor in this potential algorithmic shift, is forecasted to be embraced by nearly 75% of the companies surveyed. The impact on employment is mixed, with half of the organizations foreseeing AI-driven job growth and a quarter predicting job losses. This changing landscape indicates a more nuanced and evolving integration of human and machine collaboration in the workplace.

As illustrated in Figure 1, there is a noticeable trend of increased prioritization of AI strategies across different industries. This increase, however, is not directly aligned with specific projections for the coming years. There is no clear correlation between the emphasis on training employees to utilize and interpret AI and big data and the anticipated direct investment in AI over the next

five years. The figure underscores a complex landscape where the push towards AI competencies does not necessarily reflect broader strategic intentions or investment predictions related to artificial intelligence and automation.

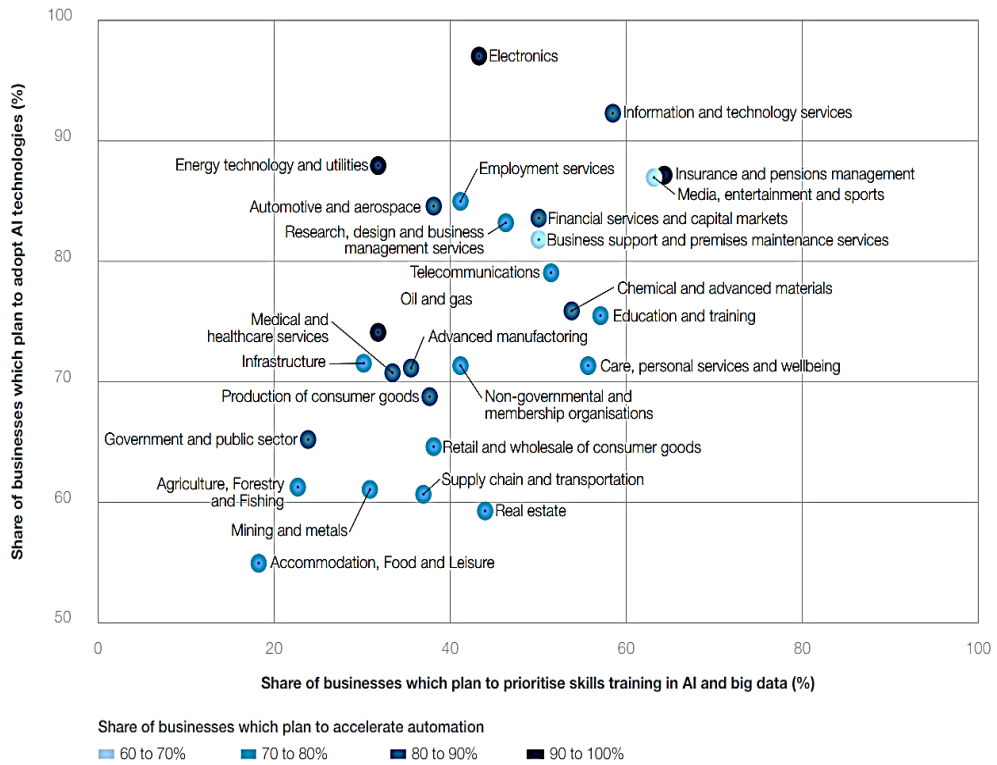


Figure 1. Artificial intelligence strategies, 2023 to 2027
 Source: (World Economic Forum, 2023)

Recent IBM study shows a steady growth pattern of AI adoption on Global level (Figure 2). As of now, 35% of companies have integrated AI into their operations, marking a four-point increase from 2021. Additionally, 42% of companies are currently exploring AI possibilities. This adoption is not merely about embracing new technology but also driven by a desire to augment automation of tasks and cut expenses. A noteworthy aspect of this trend is the widening gap between larger and smaller companies in terms of AI deployment. Larger firms are now 100% more likely to have incorporated AI into their operations compared to smaller companies, a substantial increase from the 69% likelihood in the previous year. This growth underscores the accelerating pace at which AI is becoming a central part of the business strategy, especially among

larger organizations, and the emerging disparities between different sized companies.

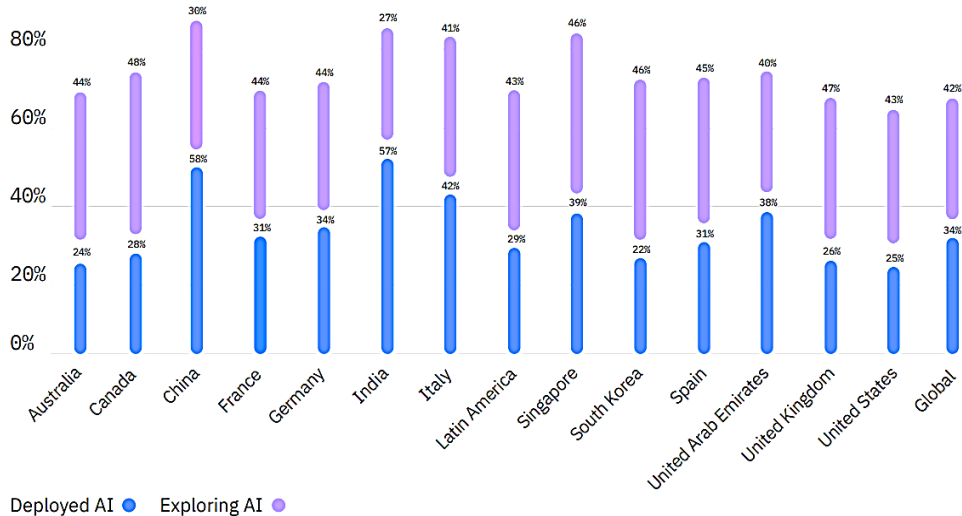


Figure 2. AI adoption and strategy.

Source: (IBM, 2022)

AI-Enhanced Jobs. Simultaneously, AI is not merely replacing human labour but also complementing and enhancing it. Many professions now rely on AI-driven tools to augment human decision-making, as in the cases of diagnostic AI in healthcare or algorithmic trading in finance. This synergy between human intelligence and artificial intelligence is fostering creativity and innovation, leading to new job roles and career paths that require specialized skills. For instance, AI-powered marketing platforms enable personalized customer engagement, creating roles for data analysts and digital marketing specialists.

Ultimately, the narrative surrounding AI and automation is not one-dimensional. While some jobs are indeed susceptible to automation, others are being enriched and transformed, revealing a complex interplay between technology and human capital (Brynjolfsson, Tom, & Rock, *What Can Machines Learn, and What Does It Mean for Occupations and the Economy?*, 2018)

3. Economic Implications

Impact on GDP. The integration of AI and automation technologies into various industries is leading to significant increases in productivity and efficiency, which in turn positively impacts Gross Domestic Product (GDP). Generative AI’s impact on productivity could add the equivalent of \$2.6 trillion to \$4.4 trillion annually to the global economy. This would increase the impact of all artificial intelligence by 15 to 40 percent. (Chui, Hazan, & Roberts, 2023) In

manufacturing, automation technologies have streamlined production lines, reducing labour costs, and minimizing errors (Daugherty & Wilson, 2018). In sectors like healthcare and finance, AI-driven solutions have not only enhanced service quality but also made services accessible to broader segments of the population (Bughin, Seong, & Manyika, 2018)

Wage Gap. While the broader economic benefits of AI and automation are evident, these technological advancements are also contributing to a widening wage gap between high-skilled and low-skilled workers. Automation has displaced many low-skilled jobs, leading to wage stagnation or decreases in these segments (Frey & Osborne, 2017). Simultaneously, high-skilled workers who can leverage these new technologies are experiencing wage increases (Goldin & Katz, 2008). Some researchers emphasize that automation has created a "hollowing-out" effect, eroding middle-wage occupations and polarizing the labour market into high and low-wage segments. This polarization has implications for social mobility and income inequality, which could lead to broader societal challenges if left unaddressed (Piketty, 2015).

Shift in Economic Power. The regions and countries that are at the forefront of AI and automation technologies may also experience shifts in economic power. Being a hub for technological innovation, the United States, along with China, is positioning itself as a global leader in the AI arena (Lee & Li, 2018). Such technological dominance might lead to a redistribution of global economic influence, possibly affecting international trade dynamics and geopolitical relationships.

4. Societal Challenges

Skills Gap. The rise of AI and automation has led to a shift in the skills required in the workforce. Traditional skills, particularly those related to manual and routine tasks, are becoming less relevant, while the demand for technical, analytical, and soft skills is increasing (Bessen, 2019). According to the (World Economic Forum, 2023), more than half of all employees will require significant re- and up-skilling by 2027. Educational institutions are grappling with this transformation, and there is a growing need for continuous learning and adaptability in curricula. Collaborations between industry and academia to design relevant educational programs have shown promising results in some regions (Haenlein & Kaplan, 2021)

Research conducted by World Economic Forum (Figure 3) depicts overarching shifts that will redefine cross-functional workplace abilities over the next half-decade. Although self-efficacy skills are currently deemed highly significant, they are expected to take a back seat in skills strategies from 2023 to 2027, following recent upheavals. In contrast, technology-related competencies

will garner more attention relative to their present importance, with specific focus on areas such as AI and big data.

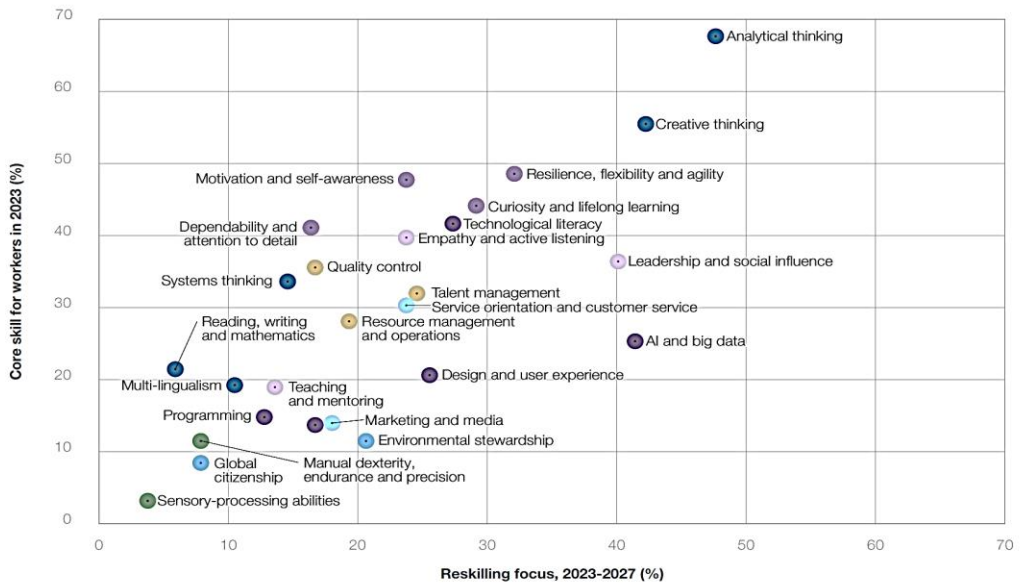


Figure 3. The evolving skills landscape, 2023-2027
 Source: (World Economic Forum, 2023)

Ethical Considerations. The proliferation of AI and automation also raises ethical concerns, particularly in terms of bias, privacy, and accountability. Algorithmic bias, where AI systems unintentionally reproduce societal biases, has been a significant concern, leading to discrimination in areas like hiring, lending, and law enforcement (O’Neil, 2017). Efforts to create fair and transparent algorithms are a subject of ongoing research and policy debate. The increased reliance on data-driven systems also raises privacy concerns, as personal information becomes central to AI-enabled services. The implementation of regulations like the General Data Protection Regulation (GDPR) in Europe has been one step towards addressing these challenges.

Social Cohesion. As AI and automation reshape labour markets, the potential increase in inequality and job displacement may lead to social tension and unrest (Acemoglu & Restrepo, 2018). Policies that ensure the benefits of technological progress are widely shared, and mechanisms to support displaced workers are critical to maintaining social cohesion.

The societal response to these technological changes is complex and multifaceted, requiring coordinated efforts across government, industry, education, and community organizations. A thoughtful approach to the integration of AI and automation can help build a society that leverages technological

advancements while preserving human dignity, equality, and social stability. (Stiglitz, 2020)

5. Future Perspectives

a) Continuous Evolution of the Job Market

The labour market will continue to evolve in tandem with advancements in AI and automation. Future jobs may require even more specialized skills, not just in technology but in the understanding of interdisciplinary applications. The integration of AI into creative fields, such as art, music, and literature, will likely forge new career paths that blend technology with human creativity.

2023 World Economic Forum research provides a more detailed inside of the future transitions. Though AI and big data currently rank 15th as a vital skill for widespread employment, their priority is set to soar in the coming years. They stand as the third-most prioritized skill in general company training plans through 2027 and number one for larger corporations with over 50,000 employees. Certain industries, including Insurance and Pensions, Management, Media, Entertainment and Sports, Information and Technology Services, Telecommunications, and Electronics, prioritize AI and big data most strongly. The emphasis on AI and big data even surpasses traditional technological skills like human computer programming, networks, cybersecurity, and design and user experience by a significant margin. Predicted to constitute over 40% of tech training programs in the next five years in countries like the United States, China, Brazil, and Indonesia, AI and big data have become central to technological evolution. Design and user experience follow as the next significant skill but fall behind AI and big data in most countries and industries. Despite some opinions that AI and big data may have been overemphasized and will decline in importance, a net 59% of companies predict their growth. Thus, while generative AI has the potential to displace jobs, the emphasis on training in these areas highlights the shift toward new opportunities and business goals. (World Economic Forum, 2023)

The Pew Research Centre has undertaken a study (Table 1) to explore the exposure of American workers to artificial intelligence, focusing on how AI might replace or assist various job activities. The term 'exposure to AI' refers to how likely job activities are to be replaced or augmented by AI. The researchers show that jobs differ in their levels of exposure to AI. Some activities, like equipment repair, have low exposure, while others may have medium or high exposure. Certain tasks like "getting information" or "analysing data" may be replaced or aided by AI. Jobs such as judicial law clerks and web developers are more exposed to AI, while others like nannies are less exposed, as AI cannot perform tasks like caring for others.

It's still unclear if exposure to AI will lead to job losses. AI may replace some jobs but may also create new opportunities and enhance existing roles, leading to more overall employment. Higher-paying, white-collar jobs may see more exposure to AI. Industrial robots might reduce employment and wages, particularly impacting low-wage workers, and those with less education. Analytical skills like critical thinking, writing, science, and mathematics are more essential in jobs with more exposure to AI, while mechanical skills are more vital in jobs with less exposure to AI.

Table 1. Occupations with different levels of exposure to AI

low exposure to AI	medium exposure to AI	high exposure to AI
Barbers	Chief executives	Architectural and civil drafters
Child care workers	Credit authorizers, checkers and clerks	Billing and posting clerks
Dishwashers	Customer service representatives	Biological technicians
Elevator and escalator installers and repairers	Education and child care administrators	Bookkeeping, accounting and auditing clerks
Fence erectors	Fashion designers	Commercial and industrial designers
Firefighters	Financial examiners	Computer hardware engineers
Gambling services workers	Fundraisers	Court reporters and simultaneous captioners
Helpers – installation, maintenance and repair workers	Human resources managers	Credit analysts
Janitors and building cleaners	Interpreters and translators	Data entry keyers
Landscaping and groundskeeping workers	Lodging managers	Judicial law clerks
Laundry and dry-cleaning workers	Marketing managers	Loan interviewers and clerks
Maids and housekeeping cleaners	Materials engineers	Medical transcriptionists
Nursing assistants	Medical scientists	Other drafters
Orderlies and psychiatric aides	Postsecondary teachers	Paralegals and legal assistants
Passenger attendants	Public relations specialists	Payroll and timekeeping clerks
Personal care aides	Purchasing managers	Production, planning and expediting clerks
Pipelayers	Sales engineers	Proofreaders and copy markers
Pressers, textile, garment and related materials	School psychologists	Switchboard operators, including answering service
Sawing machine setters, operators and tenders, wood	Teaching assistants	Tax preparers
Skin care specialists	Veterinarians	Title examiners, abstractors and searchers

Source: (Which U.S. Workers Are More Exposed to AI on Their Jobs?, 2023)

b) Universal Basic Income (UBI)

The rise of automation and artificial intelligence has accelerated the conversation around UBI, a radical policy proposal that seeks to address job displacement and income inequality. At its core, UBI represents an unconditional payment made to all citizens of a nation or region, regardless of employment status, income level, or any other factor. As automation continues to replace or augment human labour across various sectors, there is a growing concern over the potential loss of jobs and the resulting social and economic impact. UBI aims to provide financial stability and a safety net to individuals, allowing them to pursue education, entrepreneurship, or other activities without the immediate pressure of earning a livelihood.

Several countries have explored or experimented with UBI.

- Finland conducted a two-year UBI trial from 2017 to 2018, providing monthly payments to a select group of unemployed individuals. The outcomes indicated positive impacts on participants' well-being and trust in social institutions, though the effects on employment were mixed. The experiment sparked global interest and provided key insights into how UBI might function in a society grappling with automation's effects.
- Canada. A pilot program in Ontario offered payments to low-income residents but was prematurely terminated, leaving mixed evidence about its success.
- The Netherlands: Several Dutch cities experimented with variations of UBI, focusing on removing conditions from existing welfare benefits. Initial findings were inconclusive.
- Namibia: A pilot project in a Namibian village showed promising results in terms of poverty reduction and economic activity.

Real-world experiments with UBI have provided valuable data but also revealed the complexities of implementing such a system on a larger scale. As automation continues to reshape the labour landscape, the lessons learned from these trials may prove essential in crafting policies that balance financial stability, social welfare, and economic vitality. The debate on UBI is far from settled, but these real cases provide a foundation for ongoing exploration and consideration of how UBI might fit into a future where automation plays a significant role.

c) Emphasis on Lifelong Learning

Technological advancements are occurring at an unprecedented pace, underlining the critical importance of continual learning and adaptability. A cooperative effort between governments, educational entities, and employers is essential in crafting lifelong learning opportunities. This ensures that workers remain equipped to transition into new roles and industries as technological paradigms shift.

In the job market, the traditional career path is becoming obsolete. Lifelong learning helps in maintaining relevance in a fluid market where roles and requirements constantly shift. Automation and digitization may render certain jobs redundant, but lifelong learning empowers individuals to transition smoothly into new roles or industries, fostering career longevity.

Economically, lifelong learning provides avenues for social and economic mobility, offering education and skill development opportunities to all, regardless of age or background. It plays a crucial role in bridging the skill gap between different social groups, promoting equal opportunities for employment and advancement.

On a personal level, continuous learning fosters intellectual curiosity, critical thinking, and creativity, contributing to overall growth and satisfaction. It also cultivates a mindset of adaptability and resilience, essential for personal and professional success in a rapidly changing world.

The necessity of lifelong learning transcends traditional educational goals and permeates every aspect of modern life. It's a vital component in shaping resilient, innovative, and inclusive societies that can adapt to the incessant flux of technological, economic, and social changes. (Field, 2006). As highlighted in the (European Commission, 2020) 'European Skills Agenda for sustainable competitiveness, social fairness and resilience' an emphasis on continuous learning and skills development is crucial for maintaining competitiveness in the global economy. This agenda emphasizes not only the economic benefits but also the social importance of lifelong learning in fostering inclusion and resilience.

d) Ethical AI Governance

The emergence of AI has prompted an urgent need for ethical governance. Alongside technological advancements, AI has also brought forth complex ethical challenges requiring international attention and cooperation. One such international guideline is the OECD Principles on Artificial Intelligence, which sets forth key values including transparency, fairness, and accountability in AI systems (Salvi del Pero, Wyckoff, & Vourc'h, 2022). This framework serves as a global standard, guiding countries and organizations in their responsible management of AI.

However, ethical governance extends far beyond these principles. Many countries have taken significant legislative steps. For example, the European Union's General Data Protection Regulation (GDPR) has provisions that impact AI, particularly regarding the right to explanation for algorithmic decisions. Further, the EU has proposed specific legislation on AI, addressing high-risk AI systems' compliance and governance.

In the United States, the Algorithmic Accountability Act of 2022 mandates that companies evaluate the effects of the automated systems they

utilize and market. This legislation not only brings about greater transparency regarding the usage and implementation of automated systems but also enables consumers to make knowledgeable decisions concerning the automation of essential processes.

These legislative actions highlight a growing recognition of the unique challenges that AI presents, such as algorithmic biases, potential infringements on privacy, and ethical dilemmas related to autonomous systems. Addressing these issues requires ongoing collaboration and the development of new standards, auditing tools, oversight committees, and educational initiatives around AI ethics. The future of AI will undoubtedly be shaped by both its technological capabilities and how it is governed. This continuous journey towards ethical AI governance, though complex, is essential. It involves legal, ethical, and social considerations that uphold the dignity and rights of individuals, ensuring a future where AI can enhance human life without undermining human values.

e) Environmental Considerations

Environmental considerations are becoming an increasingly vital aspect of AI and automation development. As these technologies continue to proliferate, so does the demand for energy and resources required to power and produce them. From data centres consuming vast amounts of electricity to the manufacturing processes involved in creating hardware components, the environmental footprint of AI and automation cannot be overlooked.

A significant study by (Strubell, Ganesh, & McCallum, 2019) pointed out the energy consumption of training complex AI models, raising awareness about the environmental impacts of these technologies. Such findings highlight the need for a balanced approach that considers not only the technological advancements but also the sustainability of the methods employed.

As AI and automation evolve, the focus must increasingly shift towards energy-efficient and environmentally friendly innovations. This involves developing less power-consuming algorithms, utilizing eco-friendly materials, and incorporating sustainable practices such as responsible recycling of hardware components. Regulations, industry standards, and consumer expectations are instrumental in steering this transition. Collaborations among technologists, environmental experts, policymakers, and other involved parties can align the growth of these technologies with broader environmental stewardship goals. Recognizing and addressing the environmental impacts of AI and automation will not only shape our technological landscape but also determine the sustainability of our planet. The choices we make today will resonate with future generations, underscoring the importance of a balanced and responsible approach to AI and automation development.

6. Conclusion

The integration of AI and automation into various aspects of daily life and industry sectors is far more than a mere technological shift. It represents a profound transformation, influencing the core structures of our economy, society, and prospects. The multifaceted findings of this comprehensive analysis extend well beyond simple improvements in efficiency and productivity.

On one hand, there's a tangible risk that widespread implementation of AI technologies could lead to significant job displacement, particularly in roles heavily dependent on routine tasks. The slower pace of automation, as evidenced by recent data, provides some cushion, but the direction towards increased machine involvement in functions such as reasoning and decision-making highlights the need for vigilance.

On the other hand, AI and automation present opportunities for positive transformations within the workforce. They can augment human capabilities, foster innovation, and create new roles and industries that we might not yet fully envision. The integration of AI into business operations has already shown potential for enhancing efficiency, opening doors to job growth in sectors such as tech development, ethical AI governance, and environmental sustainability of technology.

The exploration of lifelong learning underscores the necessity of continuous skill development as the landscape of work changes. The notion of adaptability and the need for education that evolves alongside technology is central to ensuring that workers are equipped to thrive in an ever-changing labour market. It's a call for both individual growth and systematic efforts to provide training, resources, and support.

The study of Universal Basic Income as potential remedy for job loss due to automation indicates that although its effectiveness remains a subject of discussion, the introduction of UBI marks a revolutionary shift in considering how society may adapt to changes in employment caused by automation.

The balance between human and machine labour, the ongoing dialogue around ethical AI governance, and the renewed emphasis on sustainable development all reflect a labour market in flux. It's a market that is being shaped by technological advancement, ethical consideration, environmental stewardship, and the broader social and economic context of the past three years.

In conclusion, the labour markets of today and tomorrow are characterized by transformation, adaptation, and innovation. The way forward requires collaboration between educators, policymakers, industry leaders, and individuals, all working towards a labour landscape that recognizes the potential of AI and automation while valuing human skills and ingenuity. The insights gleaned from this analysis contribute to an essential and ongoing conversation about how to

navigate the evolving world of work, fostering an environment that is both technologically advanced and human centric.

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