The Economic Impact of Generative AI:

THE FUTURE OF WORK IN JAPAN

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Access Partnership   GLOCOM

Contents

Executive Summary

Artificial Intelligence (AI) holds much promise for Japan, with the Japanese Government's AI Strategic Council recognizing the country's high degree of affinity with generative AI, partly due to its high levels of research and technology, and the potential that generative AI holds to address issues such as the decline in the working age population and need for digitalization.[1] Recently, the Liberal Democratic Party (LDP) released its AI White Paper recognizing the need to formulate a new national strategy for AI which acknowledges this growing evolution and social implementation of large-scale language AI models where a new era of AI is envisioned.

Against this background, technology industry leaders have noted that AI is at an inflection point, with powerful new models like generative AI being introduced, and innovative new applications increasingly being used across society and capturing the imaginations of consumers. Generative AI has opened the door to more possibilities and is expected to play a role in tasks requiring creativity, curiosity, and looking at information differently. Therefore, the potential of generative AI lies in its ability to enable people to achieve greater creativity, effectiveness, and efficiency in their work.

This report seeks to contribute to this discussion by providing early insights and raising awareness of the economic opportunities that generative AI can create, and what it means for local industries and workforce readiness.

This study estimates that generative AI can potentially unlock **JPY148.7 trillion (USD1.1 trillion)** of productive capacity in Japan, equivalent to a quarter of GDP in 2022.[2] Japan has an opportunity to better position its businesses and workers to unlock the potential of generative AI, as well as manage emerging risks. Policymakers will need to ensure that they have a clear national vision for AI, and that it focuses on preparing its workforce and establishing an enabling policy environment for AI adoption, including to answer the question *"what is required to achieve the aspirations of a brighter future enabled by generative AI?"*

Three channels of change

There are three main channels through which generative AI will change the processes of production within an economy and reprioritize the types of tasks undertaken, and skills needed in the workforce.

- **Unleashing Creativity:** Generative AI can contribute to the creative process by reducing the time and cost involved in generating new ideas and producing innovative outputs. Some of Japan's manga authors are also looking to generative AI to provide creative inspiration, although it will be important to ensure that the works of artists are recognized, and their rights protected.[3]

- **Accelerating Discovery:** The use of generative AI can help accelerate the process of scientific research and discovery by reducing the cost of research and supporting better learning outcomes. Leading Japanese pharmaceutical companies are looking to leverage a generative AI-powered supercomputer to accelerate the drug discovery process, which could help improve patient outcomes and reduce costs.[4]

- **Enhancing Efficiency:** Generative AI can play a role in enhancing workplace efficiency by supporting tasks requiring parsing of big data sets and information sources. The use of generative AI can also help improve the usability of this data and information, making it more interpretable and useful for decision-making. Panasonic has begun a large-scale deployment of generative AI to assist with tasks such as document drafting, in order to help improve productivity.[5]

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[1]   AI Strategic Council (2023). *Tentative Summary of AI Issues*. Available at: https://www8.cao.go.jp/cstp/ai/ai_senryaku/2kai/ronten_youshi_eiyaku.pdf

[2]   The financial figures in this report are estimated in US dollars. Conversions, where applicable, are based on the average exchange rates in 2022 of 1 USD to 131.46 JPY, obtained from Exchangerates.org.uk.

[3]   Bilyonaryo (2023). *ChatGPT turns to manga in 'One Piece' author experiment*. Available at: https://bilyonaryo.com/2023/03/03/chatgpt-turns-to-manga-in-one-piece-author-experiment/technology/#gsc.tab=0

[4]   Bio-IT World (2023). *NVIDIA and Mitsui Launch Japan's First Generative AI Supercomputer to Accelerate Drug Discovery*. Available at:
https://www.bio-itworld.com/news/2023/04/14/nvidia-and-mitsui-launch-japan-s-first-generative-ai-supercomputer-to-accelerate-drug-discovery

[5]   Nikkei (2023). *Panasonic unit deploys ChatGPT-style AI to improve productivity*. Available at: https://asia.nikkei.com/Business/Companies/Panasonic-unit-deploys-ChatGPT-style-AI-to-improve-productivity

The opportunity for Japan

Understanding the potential impacts on industries, jobs, and skills will allow policymakers, business leaders, and workers to better prepare for, and take advantage of the capabilities of generative AI.

Generative AI can unlock JPY148.7 trillion (USD1.1 trillion) in productive capacity in Japan, with implementation by the Manufacturing sector likely contributing close to 40% of the potential economy-wide gains.

Japan's Manufacturing sector is potentially the biggest contributor to the economy-wide gains from generative AI, largely because it comprises a large share of the local workforce and account for high labor productivity. Furthermore, the workers within the Education, Health, and Social Work, Manufacturing and Wholesale and Retail Trade sectors are responsible for a large share of total work activities which could be transformed by generative AI given that they comprise a large share of the local workforce, which means that leveraging the benefit of generative AI in these sectors could transform the work experience for a large number of workers in Japan.

Generative AI will change the focus within jobs, rather than replace them entirely – and there is potential for most workers to use generative AI to some degree in their work.

While only a small share (1%) of the Japanese workforce would see generative AI used in more than 20% of their work, almost three quarters (69%) of workers in Japan will potentially use generative AI for between 5-20% of their regular work activities.

Capturing the economic opportunities that generative AI presents will require equipping the workforce with the future-ready skills to thrive in an AI-powered future.

The basic skills of Reading, Writing, and Critical Thinking remain essential skills to engage with and interpret generative AI applications. The cross-functional skills of Operations Monitoring, Coordination, and Management of Material Resources should be evaluated as to how they are recontextualized for generative AI in the workplace.

Furthermore, it will be important to close the digital skills gap in Japan by continuing to focus on digital literacy, as well as to improve AI aptitude—the ability to operate in an AI environment and leverage AI tools.[6] This includes learning how to manipulate and apply AI technologies across a range of situations and use functions to enhance existing work tasks for more effective and efficient results.

Japan ranked 29th in the 2022 World Digital Competitiveness Ranking, signaling that there may be room to improve in areas such as training and education.[7] To better leverage the opportunities of generative AI, it will be imperative that students are exposed to digital literacy education. Over the past two years, the Japanese government has made considerable effort to integrate ICT education in Japanese schools through its Global and Innovation Gateway for All (GIGA) School Program providing students with computer devices and high-speed communications networks to foster their digital competencies.[8] It will be important to build on this momentum with other efforts.

[6] Kenan Institute of Private Enterprise (2023). *The Must-Have Skills in the Era of Artificial Intelligence: How AI's Democratization Will Impact Workers.* Available at: https://kenaninstitute.unc.edu/commentary/the-must-have-skills-in-the-era-of-artificial-intelligence-how-ais-democratization-will-impact-workers/

[7] IMD (2022). *Digital Competitiveness Ranking Japan.* Available at: https://worldcompetitiveness.imd.org/countryprofile/JP/digital

[8] Japan Gov (2021), *ICT in Schools Equips Students with Life Skills for Digital Era.* Available at: https://www.japan.go.jp/kizuna/2021/04/ict_in_schools.html

Harnessing the potential of generative AI

Leveraging generative AI to accelerate economic growth will require a comprehensive, coordinated approach that addresses not only the technological aspects of AI, but also the social, economic, and ethical implications of the technology. A policy framework that takes these factors into account will be necessary to maximize the gains from AI whilst mitigating the risk from such economic transformation. We present a framework of recommendations to drive AI use for consideration by government and business leaders, focused on three main policy objectives.

1. **Increasing access and adoption:** Ensuring the development of the necessary AI-ready infrastructure with fit-for-purpose, enabling digital policies and regulations. This includes supporting the AI-transition for businesses and having the right workforce readiness policies.

2. **Mitigating risks:** Recognizing that there are risks and this requires a coordinated effort particularly on guiding responsible and ethical use of AI and establishing the necessary organizational checks and balances when using AI.

3. **Inspiring innovation:** Finding the right balance between protecting and promoting innovation.

To capture the abundant economic opportunities that generative AI could unlock, a coordinated effort will be necessary to prepare for its widespread adoption. This will require multiple stakeholders, from government, industry, academia, civil society, and the broader community to engage in the topics of how to best leverage generative AI and manage its risks.

1 Introduction

Artificial Intelligence (AI) holds much promise for Japan, with the Japanese Government's AI Strategic Council recognizing the country's high degree of affinity with generative AI, partly due to its high levels of research and technology, and the potential that generative AI holds to address issues such as the decline in the working age population and need for digitalization.[i] The Japanese government has been focused on enabling AI development with the country's AI market expected to reach USD27.1 billion by 2032.[ii] Most recently, the Liberal Democratic Party (LDP) released its AI White Paper recognizing the need to formulate a new national strategy for AI which acknowledges this growing evolution and social implementation of large scale language AI models where a new era of AI is envisioned.[iii] Looking to take advantage and to be internationally competitive, Japan looks to plan, develop, and strengthen its own AI development capacity to ensure its upcoming AI national strategy recognizes generative AI developments.

Against this background, technology industry leaders have noted that AI is at an inflection point, with powerful new models like generative AI being introduced, and innovative new applications increasingly being used across society and capturing the imaginations of consumers. Generative AI has opened the door to more possibilities and is expected to play a role in tasks requiring creativity, curiosity, and looking at information differently. Therefore, the potential of generative AI lies in its ability to enable people to achieve greater creativity, effectiveness and efficiency in their work.

Japan has an opportunity to better position its businesses and workers to take advantage of generative AI, as well as manage emerging risks. Policymakers will need to maintain efforts to implement its economy-wide approach to generative AI to ensure its workforce and policy environment are prepared for the opportunities it creates. **This report seeks to contribute to these efforts by providing early insights and raising awareness of the economic opportunities that generative AI can create, and what it means for local industries and workforce readiness.**

Some of the public discourse surrounding generative AI has involved concerns about the potential effect on jobs. Such concerns are understandable, as history has shown that the introduction of new productive technologies have changed the way labor is used in production, sometimes significantly, for example, the industrial revolution, and the introduction of the internet. However, based on the findings of this study, it is likely that the implementation of generative AI will change the focus within certain jobs rather than replace jobs entirely. To achieve this potential, workers, employers, and authorities will need to make conscious choices to make the most of the new technology—similar to when horses were replaced with cars, it was a long process that required authorities to build roads, and people to learn to drive.

In order to promote AI adoption within both the public and private sectors, the LDP's AI white paper noted that there was a need to reskill the workforce to develop the capabilities of small businesses; reimagine the opportunities for products and services innovation; and revise management awareness to take advantage of potential opportunities. The whitepaper also considered AI governance issues around the development of a safe and secure environment for AI use and the need to find a balance between encouraging innovation and managing risks through an agile regulatory environment.

To capture the abundant economic opportunities that generative AI could unlock, a coordinated effort will be necessary to prepare for its widespread adoption. This will require multiple stakeholders, from government, industry, academia, civil society, and the broader community to engage in the topics of how to best leverage generative AI and manage its risks.

2 Defining the potential of generative AI

> *Generative AI refers to a category of artificial intelligence (AI) algorithms that generate new outputs based on the data they have been trained on. Unlike traditional AI systems that are designed to recognize patterns and make predictions, generative AI creates new content in the form of images, text, audio, and more.*
>
> - World Economic Forum (WEF) 2023[iv]

The WEF provides a succinct definition of generative AI. However, rather than the sophistication of the technology driving it, the public's imagination has generally been ignited by consumer-based examples of how generative AI has been used, often in innovative ways.

This application of the technology to specific work tasks is the basis of our analysis of the Future of Work. The analysis assumes that generative AI can find applications across many work activities. Along these lines, its effects are likely to be broad-based like that following the introduction of the internet, rather than like that of automation technologies which have slightly narrower applications.

While the attention has largely focused on consumer-based use cases of generative AI, it is expected that the use cases for generative AI will grow, and increasingly find relevance in business settings (Box 1). There are already examples of enterprise use cases, for example, Panasonic has begun a large-scale deployment of generative AI to assist with tasks such as document drafting, in order to help improve productivity.[v] As more and more businesses identify instances where application of generative AI can lift the burden on its workforce, it is likely that adoption rates will rise.

BOX 1

Moving from consumer to enterprise use cases

While many of the current use cases are largely consumer-based, Deloitte predicts that *"the far-reaching impacts and potential value when deploying generative AI are accelerating experimental, consumer, and soon, enterprise use cases."*[vi] They also note that the frequently cited criteria for enterprise adoption of generative AI models are:

1. Ease of use: Integrations into systems and workflows via out-of-the-box connections and low/no code tooling, reducing expensive IT resources and enabling frontline users.

2. Security and privacy: Compliance with data security standards and access control over confidential data.

3. Robust ecosystems: Broad set of development and service partners to extend, customize, and co-develop specialized data sets, use cases, and applications.

4. Transparency and explainability: Understanding how model outputs and responses are derived and the ability to perform root cause analysis on inaccurate results.

5. Flexibility and customizability: Ability to create parameters, train on proprietary data, and customize embeddings while maintaining privacy and ownership of data and tuning.

2.1 The basis of this study

As the full potential of generative AI is still being discovered, the approach taken in this study is to look across the universe of work activities and determine what generative AI would not do—the inverse of which is what generative AI could do.

This exclusionary assessment seeks to exclude three types of work activities, that require:

1. Human judgement, such as to provide checks and balances.

2. Management of inter-personal relationships, which assumes that humans still want some connection to other humans.

3. Interacting with the physical environment, such as repairing mechanical machinery, or serving food at a restaurant.

The result of this approach is a list of work activities that could potentially leverage generative AI to different degrees. Similarly, an assessment of the skills that are potentially affected by generative AI is based on an analysis of the skills most relevant to the affected work activities. More than 2,000 work activities were assessed individually, and then assessed again in the context of close to 900 occupations. The exclusionary approach effectively allows the identification of occupations and skills that could potentially leverage generative AI. The analysis does not distinguish between those occupations that will be displaced and those that will be augmented by the use of generative AI. Ultimately, the impact of technology on the workforce will depend on whether communities, businesses, and governments are prepared to reap the benefits and manage the risks.

Digitalization has often been associated with automation, but generative AI is shaping up differently and is expected to have wide-spread implications for the way we work in future:

- Generative AI will hold potential for occupations that have a higher share of non-routine work activities, moving away from the idea of affecting the most "automatable" jobs.

- Generative AI will be most transformative for work activities contributing to decision-making, including by processing large amounts of information and creating new content.

- Generative AI will transform occupations requiring greater preparation—that is, more years of education and training—and those demanding higher pay.

The determinant of what effect generative AI will have for economies will be the pace of adoption, enabling policies, and effective management of risks.

3 Three channels of change

Generative AI is about increasing access to the tools for content creation; lowering the barriers for thinkers to discover new ideas; and lifting productivity broadly. At the same time, human participation in new content creation remains important, particularly as an instigator of curiosity and an arbiter of common-sense.

On the latter point, human oversight in generative AI-produced outputs remains critical to ensuring that new content is relevant, accurate, and ethical. In part, this will help to ensure that its creative and research-related outputs avoid unwanted biases. The need for human oversight is also abundant during the AI training process, which can incorporate a large amount of human feedback to reinforce good behaviors. For example, the ChatGPT model was trained to align with human values to deliver responses that are *"helpful (the question is answered in an appropriate manner), honest (the answer can be trusted), and harmless (the answer is not biased nor toxic)."* [vii]

There are three main channels through which generative AI will change the processes of production within an economy and transform the types of tasks undertaken and skills needed in the workforce. These three channels are: (1) unleashing creativity; (2) accelerating discovery; and (3) enhancing efficiency.

3.1 Unleashing creativity

Generative AI can contribute to the creative process by reducing the time and cost involved in generating new ideas and producing new outputs. It will be important to ensure that the guardrails placed around the responsible use of generative AI include recognition for the input and contributions of human creators. Innovation will continue to need a human spark, and generative AI can play a role in supporting the creative process. Many traditionally "creative" occupations have a high share of tasks that could be transformed by generative AI, for example, workers within the Arts, Design, Entertainment, Sports, and Media sector (Exhibit 1).

The use of generative AI in content creation is widely reported, particularly in knowledge and creative industries. For example, Deloitte experimented with the use of generative AI for coding and found a 20% improvement in code development speed for relevant projects.[viii] Given generative AI's ability to provide outputs in a variety of formats—for example, text, images, video, audio, computer code, synthetic data—its potential for content generation is wide-ranging.

The use of generative AI can support the more efficient creation of new content, including in the conceptualization stage of the creative process, such as to help journalists generate story ideas, as well as in later stages, such as by providing first drafts of a novel or ideas for manga storylines (Box 2).[ix] Workers are also optimistic about generative AI's capacity to enhance creativity, with a recent Microsoft report finding that 3 in 4 people believe it will help them formulate ideas for their work. 87% of workers in creative roles have also indicated that they would be comfortable using generative AI in their jobs.[x]

Furthermore, leveraging generative AI models in content creation can facilitate the production of higher quality content. Generative AI models learn from large amounts of input data, effectively enabling users to draw from a wide range of information sources (potentially across different formats and languages), as well as leverage insights identified by such models, to produce more accurate and informative outputs. These creation capabilities of generative AI are used to produce synthetic data to help self-driving car companies to better prepare vehicles for real-world situations.[xi]

The use of generative AI could also facilitate the drafting of new content, as well as produce content in new forms. This provides an opportunity for content creators to produce more diverse and engaging content for their audiences, as well as tailor content more readily for specific audiences. For example, Coca-Cola has announced its use of generative AI to generate personalized ad copy at scale.[xii]

EXHIBIT 1

Generative AI's potential in the Arts, Design, Entertainment, Sports, and Media sector, adjusted for likelihood, by occupation (% of total affected work activities)
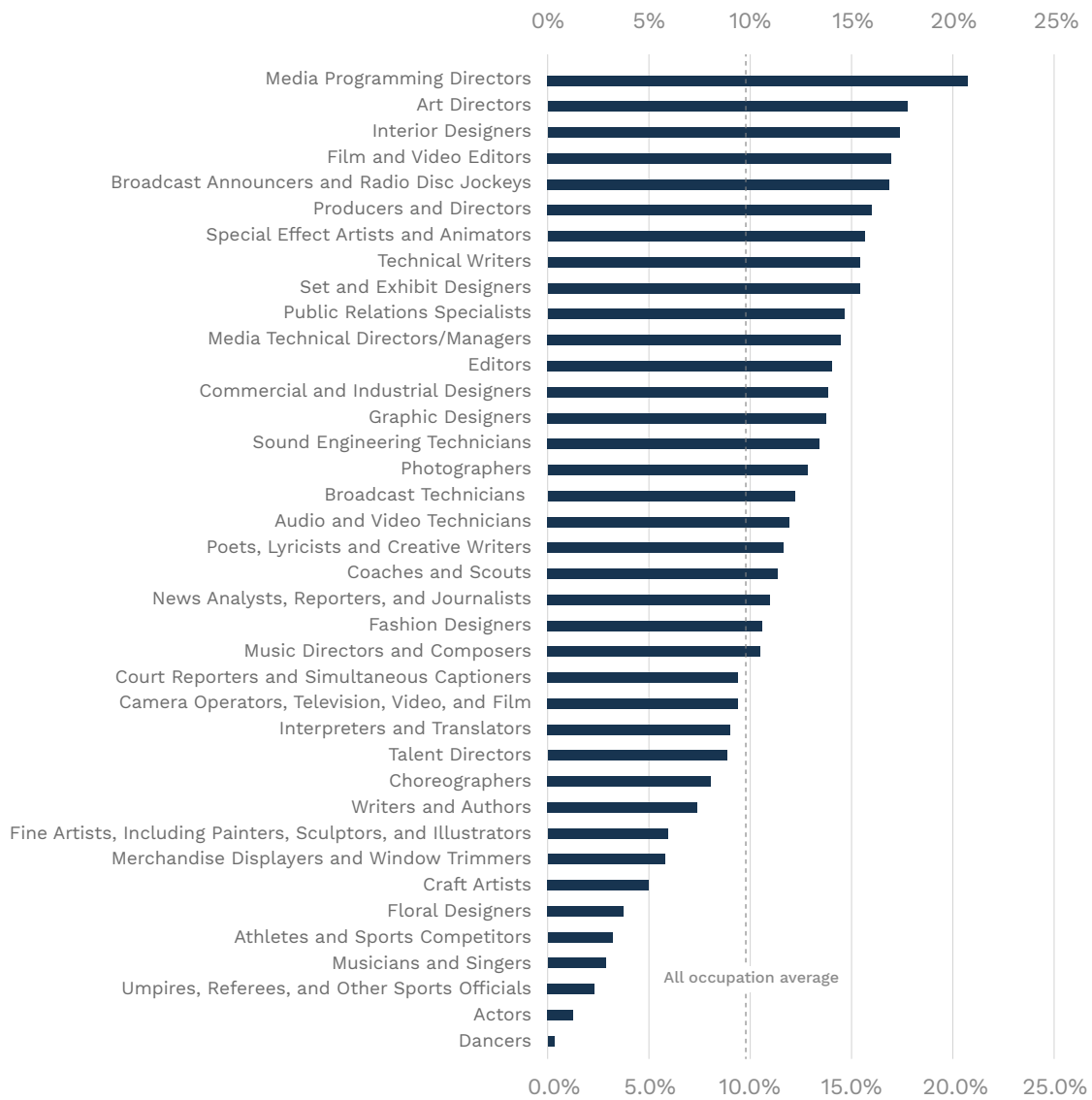
Notes: The analysis is done on a global level. These impacts have been adjusted for 'likelihood'. The adjustment for likelihood considers the potential degree of implementation of generative AI. This adjustment is categorical (i.e., low / medium / high) according to the relative pay levels for each occupation, based on an assumption that the motivation to implement is greater for higher paid jobs.
Sources: Access Partnership analysis, National Center for O*NET Development

Supporting the creative economy in Japan

Workers within the Arts, Design, Entertainment, Sports, and Media sector have significant opportunities to leverage generative AI in their work activities. The content creation potential of generative AI can open up opportunities for workers within these sectors to expand their content creation capabilities and lift content quality.

Some of Japan's manga authors are looking to AI tools like ChatGPT to provide inspiration, with Eiichiro Oda, the creator of the popular One-piece manga, noting that ChatGPT provided creative inputs that helped Oda overcome writer's block and that the next installation of One-piece will be heavily drawn from it.[xiii] One other example includes the use of generative AI by a team of researchers and artists to create the world's first AI-designed manga, PHAEDO, which leveraged Nvidia's StyleGAN to help generate new characters and stories in the style of "The Father of Manga", Osamu Tezuka.[xiv]

Against the background of using generative AI to assist in artistic creation, it will be important to ensure that the works of manga artists and illustrators are recognized, and their rights protected. Japanese legislators are assessing the level to which development of generative AI can impact creative artists.[xv]

3.2 Accelerating discovery

Generative AI has the potential to play an important role as a tool in scientific progress. The use of generative AI can help accelerate the process of scientific research and discovery by reducing the cost of research and supporting better learning outcomes. Those occupations with the greatest share of tasks that can be transformed by generative AI are occupations related to science, healthcare, and education (Exhibit 2).

Generative AI's potential, adjusted for likelihood, top ten occupations (% of total affected work activities)
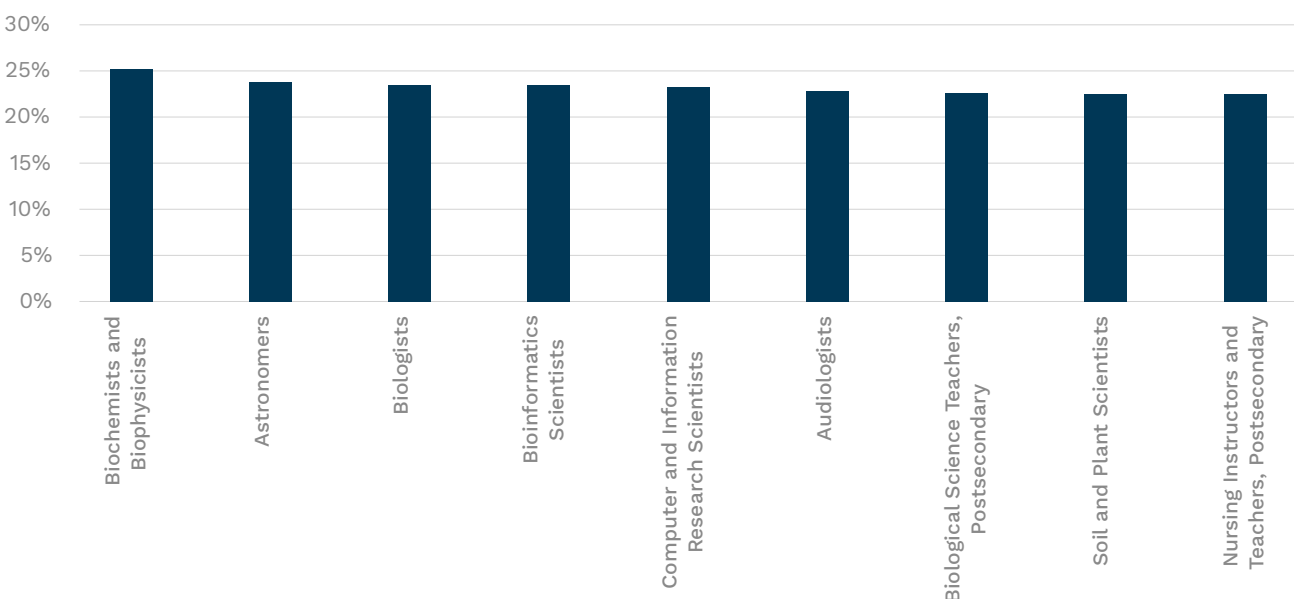
Notes: The analysis is done on a global level. These results represent occupations with the greatest share of tasks that are transformed by generative AI. The adjustment for likelihood considers the potential degree of implementation of generative AI within each occupation. This adjustment is categorical (i.e., low / medium / high) according to the relative pay levels for each occupation, based on an assumption that the motivation to implement is greater for higher paid jobs.
Sources: Access Partnership analysis, National Center for O*NET Development

Scientific breakthroughs often involve curiosity, creativity, and trial and error, but the methodical process of iterative questioning and answering is costly and time-consuming. Generative AI can help develop and test hypotheses leveraging its capabilities to interrogate the vast datasets to field and answer research questions based on the data it has been trained on. For example, generative AI has been used in the development process to create new designs for materials and medicines, significantly reducing the costs and time required from years to weeks.[xvi]

Research and development (R&D) is a significant driver of Japan's industrial competitiveness—its annual R&D expenditure averaged around 3.2% of GDP over the decade to 2020, compared to a global average of less than 1%.[xvii] Japan's Prime Minister Kishida has also offered support for the industrial implementation of generative AI technologies.[xviii] The application of generative AI may present opportunities for R&D in Japan, potentially helping to generate new ideas to unlock efficiencies during testing (Box 3). The Japanese government can provide further support by establishing innovation policies and developing new paths to commercialization to help businesses take advantage of the potential gains from generative AI. The LDP's AI White Paper also recommended to *"deepen discussions on how AI governance should be implemented not only to manage risks for private operators, but also to encourage ingenuity and innovation; and if necessary, establish guidelines".*[xix]

Furthermore, generative AI can be used as a tool to improve student learning outcomes. Increasing access and quality of school education will contribute to securing opportunities for future scientists and researchers who will contribute to future scientific discoveries.

Generative AI can also be used to tailor curriculums to students. For example, generative AI could be used to create personalized learning experiences based on an analysis of a student's learning patterns and preferences.[xx] Personalized learning can be effective in improving student learning outcomes and can be useful for engaging students with learning challenges.[xxi]

Many occupations within the Educational Instruction sector have an above average share of tasks that can be transformed by generative AI (Exhibit 3), suggesting significant opportunity.
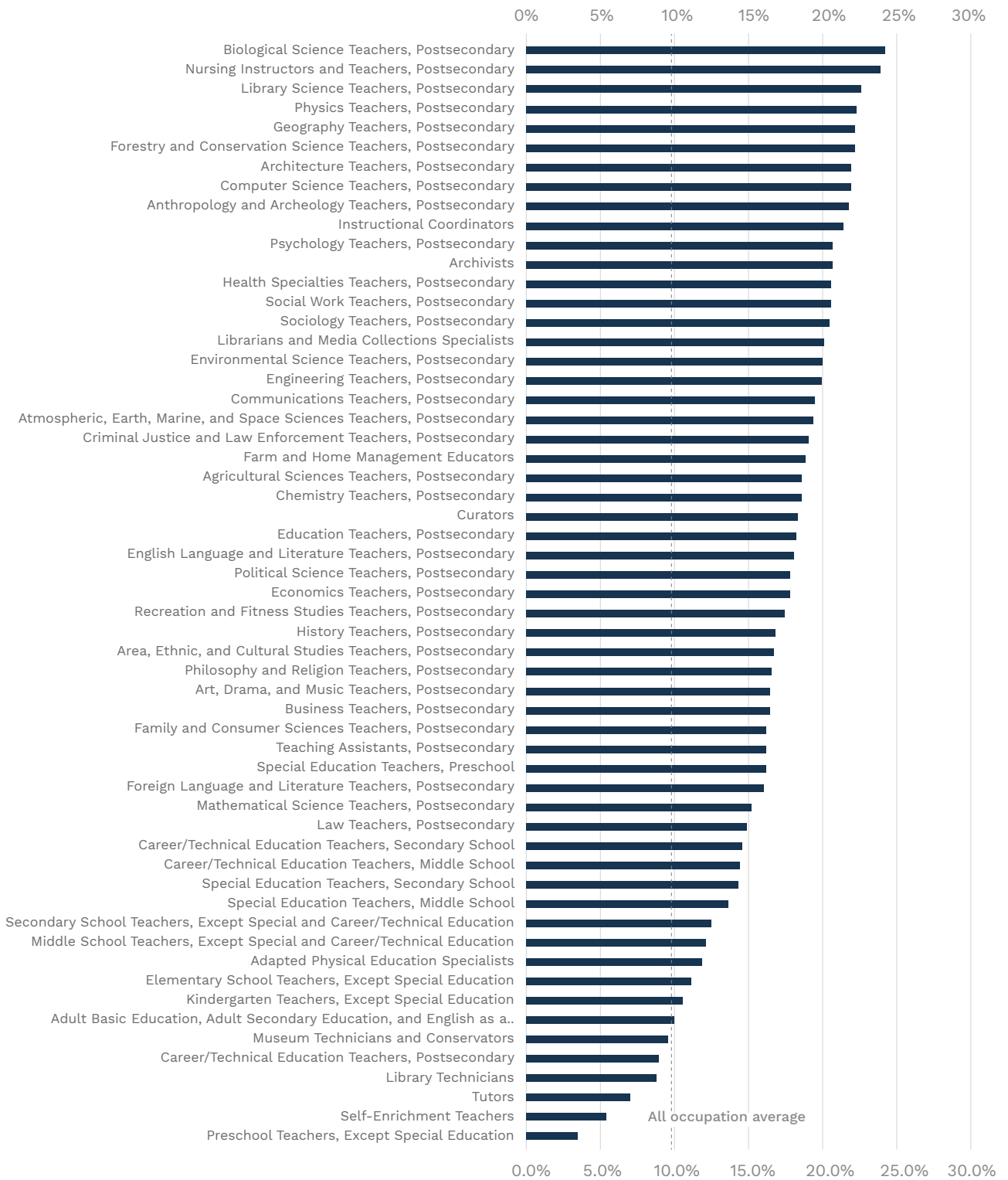
Bolstering the pharmaceutical industry in Japan

In collaboration with NVIDIA, Mitsui has launched Tokyo-1, a generative AI-powered supercomputer designed to accelerate the drug discovery process by supporting molecular dynamics simulations, large language model training, quantum chemistry, transformer model training, and molecular design.[xxii] The supercomputer employs NVIDIA's BioNeMo drug discovery software, which utilizes large language models for analysing multi-omics data and enables researchers to scale their AI models by billions of parameters. This initiative is expected to significantly enhance Japan's $100B pharmaceutical industry, with leading pharma companies such as Astellas Pharma, Daiichi-Sankyo, and Ono Pharmaceutical looking to leverage Tokyo-1 to improve patient outcomes and reduce costs.

EXHIBIT 3

Generative AI's potential in the Educational Instruction sector, adjusted for likelihood, by occupation (% of total affected work activities)

3.3 Enhancing efficiency

Generative AI can play a role in enhancing workplace efficiency by supporting tasks requiring parsing of big data sets and information sources. The use of generative AI can also help improve the usability of this data and information, making it more interpretable and useful for decision-making. The use of generative AI has applications across all industries and will hold more significant potential for industries that typically work with large amounts of data or involve complex tasks, such as financial services, professional services, scientific research, and ICT (Exhibit 4).

EXHIBIT 4

Generative AI's potential by industry, adjusted for likely impact on occupations (% of total affected work activities)
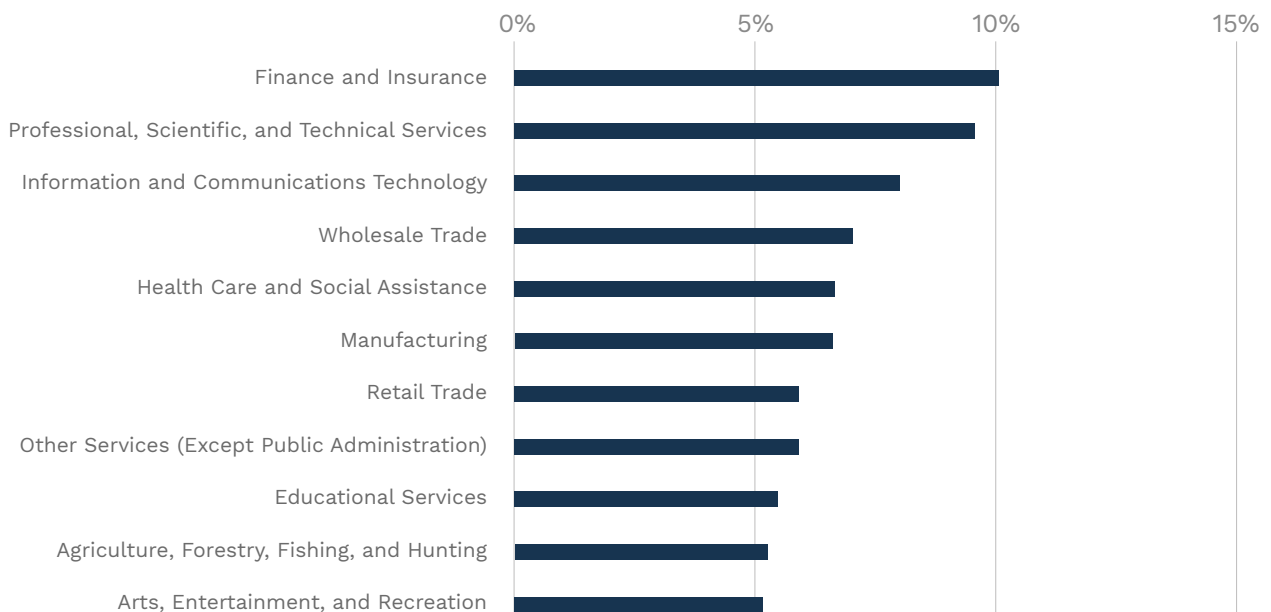

Notes: Excludes public sector, real estate, and utilities. The analysis is done on a global level. These impacts have been adjusted for 'likelihood'. The adjustment for likelihood considers the potential degree of implementation of generative AI. This adjustment is categorical (i.e., low / medium / high) according to the relative pay levels for each occupation, based on an assumption that the motivation to implement is greater for higher paid jobs.
Sources: Access Partnership analysis, National Center for O*NET Development

Nonetheless, in addition to complex tasks, a recent study of customer support agents found that those given access to generative AI tools were able to successfully solve client problems more quickly—with productivity gains of around 14%.[xxiii] Workers are also prepared to leverage these productivity benefits—a recent report by Microsoft found that 70% of people would delegate to AI to lessen their workloads, and 3 in 4 people are comfortable with using AI for administrative tasks.[xxiv] The study also noted that the least skilled workers were among those that benefited, reporting that they could get their work done 35% faster. This also suggests that the application of generative AI tools to administrative work activities could create benefits. For example, private sector businesses, such as Panasonic,[xxv] as well as the Japanese government are already considering its use to help streamline administrative work (Box 4).

BOX 4

Streamlining the public sector with generative AI

AI Strategy Team, which includes representatives from various ministries and agencies, has been set up by the Japanese government to explore the possibility of using generative AI tools, to enhance the efficiency of administrative duties while also establishing guidelines for responsible and safe use.[xxvi]

Assessments of the risks arising from the use of such technology in public administration will be an important part of these examinations. For example, the Tottori prefecture has restricted the use of generative AI in administration citing present concerns around privacy and security, while the Hokkaido Prefecture Governor has noted that the technology needs to be "handled with caution". There are also calls from academia to institute common guidelines for the use of generative AI in the public sector.

Against this background, government bodies are testing how to best leverage generative AI and there is some consideration around using generative AI to make administrative tasks more efficient, such as to assist with filling out online application forms, generating responses before parliamentary hearings, and predicting questions during news conferences
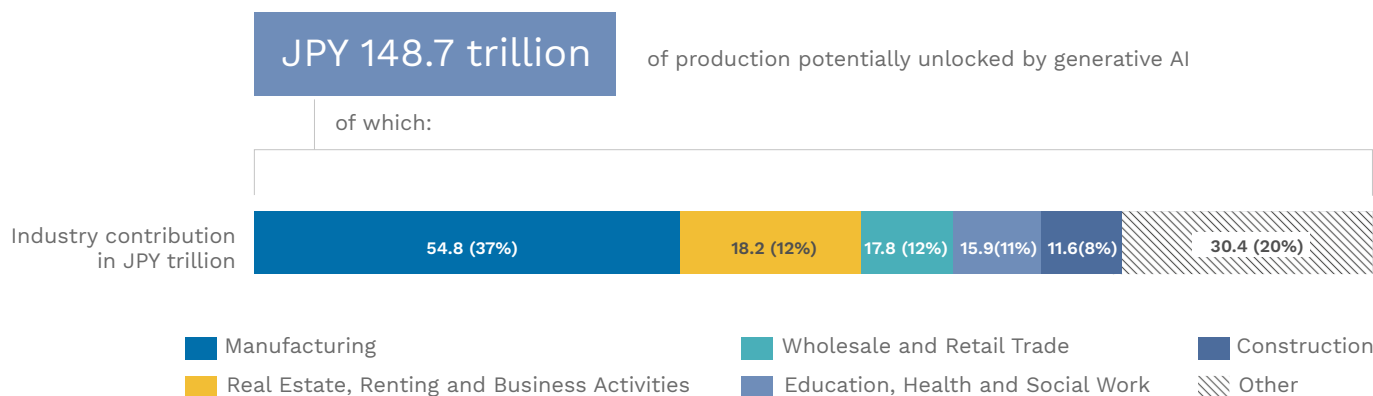
4 The opportunity for Japan

Although generative AI brings opportunities for all economies, its implications for Japan are related to the country's industry structure, workforce composition in each sector, the level of productivity and existing stock of skills in the labor force. By understanding the potential implications of generative AI on industries, jobs, and skills, policymakers, business leaders, and workers can better prepare for, and take advantage of the effects of generative AI.

4.1 Generative AI implementation can unlock economy-wide gains in productive capacity equivalent to one-quarter of GDP

The successful application of generative AI technologies across industries could help unlock additional productivity capacity. Based on an analysis of the relationship between labor and production in the Japanese economy, it is estimated that use of generative AI to supplement work activities could help unlock **JPY148.7 trillion** (USD1.1 trillion) of productive capacity across the economy, equivalent to 27% of GDP in 2022 (Exhibit 5). The Manufacturing industry is the largest contributor to this potential, largely due to the fact that it comprises a large share of the workforce and accounts for high labor productivity.

EXHIBIT 5

Production in Japan potentially unlocked by generative AI (JPY trillions)

| JPY 148.7 trillion | of production potentially unlocked by generative AI |

of which:

| Industry contribution in JPY trillion | 54.8 (37%) | 18.2 (12%) | 17.8 (12%) | 15.9 (11%) | 11.6 (8%) | 30.4 (20%) |

- Manufacturing
- Wholesale and Retail Trade
- Construction
- Real Estate, Renting and Business Activities
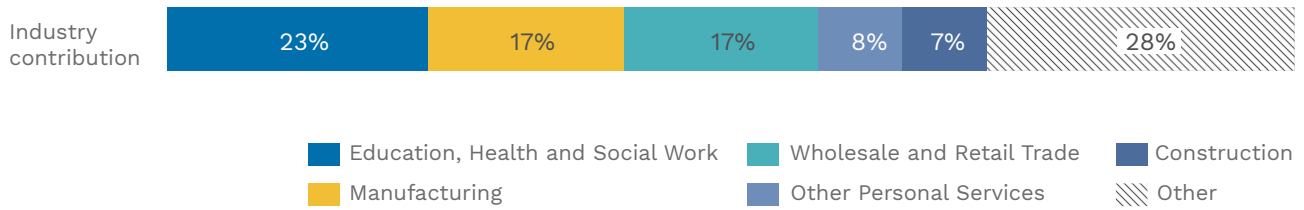- Education, Health and Social Work
- Other

Note: Other includes: Agriculture, Hunting, Forestry, and Fishing; Mining and Quarrying; Hotels and Restaurants; Telecommunications; Transport Services; Financial Intermediation; and Other Personal Services. The analysis excludes the Public Sector and Utilities.
Sources: Access Partnership analysis, ILO, National Center for O*NET Development.

There is also significant potential to leverage generative AI technology across many workforce activities. Based on an analysis of the total work activities undertaken by the workforce in Japan, work activities undertaken by workers within the Education, Health, and Social Work, Manufacturing and Wholesale and Retail Trade industries comprise the largest share of work activities potentially transformed by generative AI (Exhibit 6).[9] These activities include the drafting of lesson plans, supporting medical diagnoses, generating ideas for new product designs, drafting trade contracts, and developing targeted marketing materials. While the type of work activities within these industries may not hold the highest potential compared to other industries (Exhibit 4), they comprise a large share of the local workforce, and therefore account for a large share of total work activities within the economy. This means that leveraging the benefit of generative AI in these sectors could transform the work experience of a large number of workers in Japan.

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[9]   This analysis is based on a ground-up estimate of the detailed work activities that are undertaken within every occupation, which is then scaled up by an estimate of the composition of occupations within each industry, which is then scaled up by the size of the workforce within each industry.

EXHIBIT 6

Work activities in Japan potentially transformed by generative AI, industry contribution (%)

Industry contribution	23%	17%	17%	8%	7%	28%

■ Education, Health and Social Work   ■ Wholesale and Retail Trade   ■ Construction

■ Manufacturing   ■ Other Personal Services   ▨ Other

Note: Other includes: Agriculture, Hunting, Forestry, and Fishing; Mining and Quarrying; Hotels and Restaurants; Telecommunications; Transport Services; Financial Intermediation; and Real Estate, Renting and Business Activities. The analysis excludes the Public Sector and Utilities.
Sources: Access Partnership analysis, ILO, National Center for O*NET Development.

4.2 Generative AI will change the focus within jobs, rather than replace them entirely

The application of generative AI will change the way that labor is used in production, and it will have implications for the workforce across all industries. However, it is likely that the implementation of generative AI will change the focus within certain jobs rather than replace jobs entirely. Furthermore, many work activities, such as managing teams and interacting with customers, will still be largely undertaken person-to-person. Based on an analysis of the local workforce, the extent to which generative AI could be used will vary according to the nature of work for specific occupations. Almost every worker could use generative AI to some degree—although the level of adoption by businesses will vary in the short term. Importantly, almost three quarters (69%) of the workforce could incorporate generative AI in 5-20% of their work activities (Exhibit 7)—it is estimated that only 1% of the Japanese workforce would see generative AI used for more than 20% of their work.

As will be discussed in Section 5, this has relevance for policymakers and industry, as it illustrates that while there will be a broad demand for AI skills, the demand will be more pronounced for the share of the workforce expected to use generative AI more extensively in their work.

EXHIBIT 7

The potential to leverage generative AI in the Japanese workforce (% of total workforce)
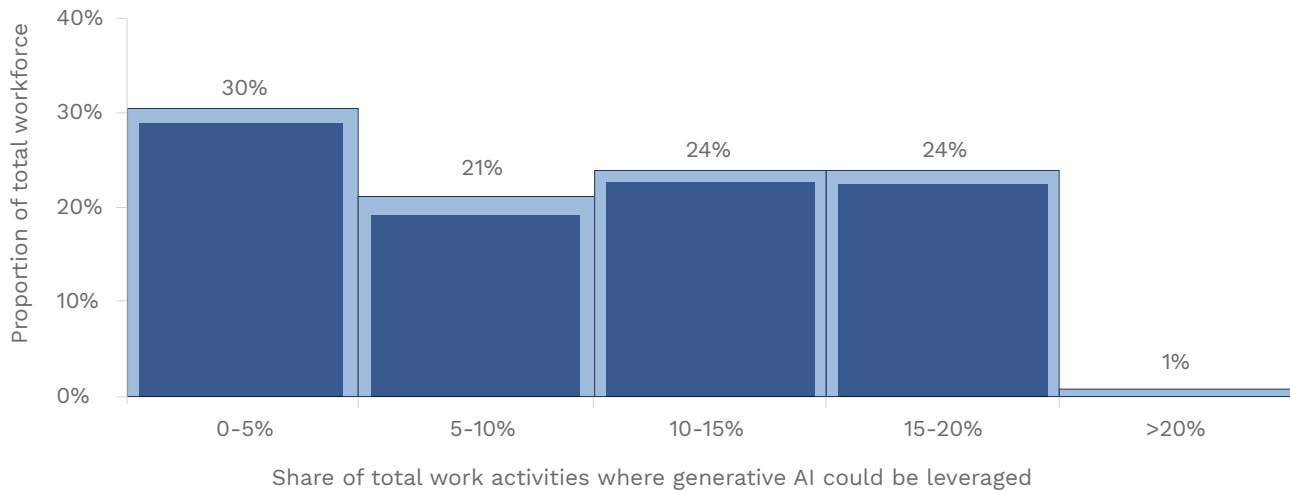
Note: The analysis excludes the Public Sector and Utilities.
Sources: Access Partnership analysis, ILO, National Center for O*NET Development.

4.3 An AI-ready workforce will require upskilling in current and future-ready skills

To capture the potential economic opportunities of generative AI, it will be important to identify the existing stock of workforce skills which will need to be uplifted, as well as the sets of new skills which will need to be developed.

4.3.1 Uplifting the current stock of skills

The basic skills of Reading, Writing, and Critical Thinking are relevant across most occupations, albeit used in differing degrees of frequency and to differing levels of proficiency. Nonetheless, the input-and-output style of generative AI, particularly when applied to content creation work activities, would seem to suggest that for such tasks, these basic skills become less important. However, it is arguable that skills such as critical thinking, particularly in context of generative AI still being susceptible to errors of data and ethics, remain a key part of the input-and-output equation. At the same time, reading and writing skills are fundamental building blocks for thinking, as well as essential skills to engage with and interpret generative AI applications. It will be necessary to rethink how such basic skills should develop in the context of generative AI, but it's likely that the answer lies in strengthening such skills rather than abandoning them.

Beyond basic skills, there are cross-functional skills specific to certain types of occupations. Based on an analysis of all the cross-functional skills that are likely to be affected by generative AI, across most industries, Operations Monitoring, Coordination, and Management of Material Resources are found to be most impacted (Exhibit 8).[10,11] This means that such priority should be given to evaluating how these skills should be recontextualized in the context of using generative AI in the workplace.

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[10]   These cross-functional skills are based on O*Net's taxonomy of 25 cross-functional skills across five categories: (1) Complex Problem Solving Skills; (2) Resource Management Skills; (3) Social Skills; (4) Systems Skills; and (5) Technical Skills.

[11]   Operations Monitoring is defined as watching gauges, dials, or other indicators to make sure a machine is working properly. Coordination is defined as adjusting actions in relation to others' actions. Management of Material Resources is defined as obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.

EXHIBIT 8

**Generative AI and its potential impact on cross-functional skills
(% of total impacted cross-functional skills)**
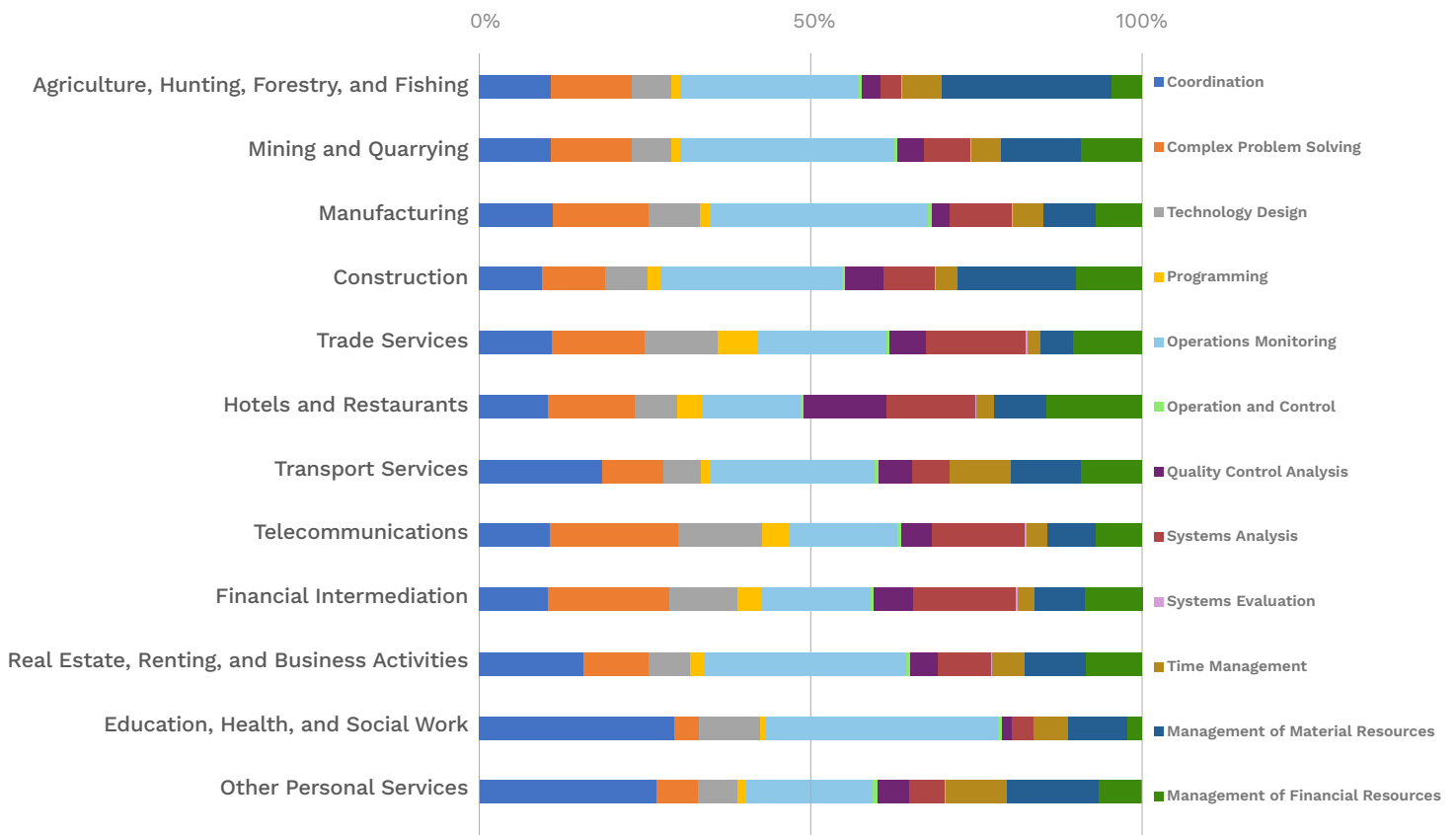
Note: The analysis is done on a global level. The analysis excludes the Public Sector and Utilities.
Sources: Access Partnership analysis, National Center for O*NET Development.

Furthermore, the work activities which are expected to be less affected by generative AI also point to both basic and cross-functional skills which will continue to be important for the workforce. These work activities relate to people-to-people interactions and tasks such as coaching, developing, and caring for others (Exhibit B.2 in Appendix B). This means that social skills around persuasion, negotiation, and giving instructions, as well as management skills around personnel management will remain core parts of the toolkit for all workers. Furthermore, in a world experiencing constant technological change, the basic skill of having learning strategies will be critical for all workers.[12] Along these lines, a recent Microsoft report found that 'analytical judgment,' 'flexibility,' and 'emotional intelligence' are at the top of the list of skills essential for employees in AI-powered future.[xxvii] The report also noted that 82% of leaders said that "their employees will need new skills to be prepared for the growth of AI". Businesses and individuals should continue to value strengthening of these skills.

4.3.2   Developing new future-ready skills

Future-ready skills in the context of AI have been considered to consist of three types: (1) skills to develop and manage AI; (2) skills to work with AI; and (3) skills to live with AI.[xxviii] The specific skills required include hard skills in areas such as computer science and data analytics for more specialized AI roles, as well as softer skills such as creativity, critical thinking, and problem-solving as AI technologies become more accessible.

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[12]   Learning Strategies refers to the capacity to select and use training/instructional methods and procedures appropriate for the situation when learning or teaching new things.

While the ubiquity and level of proficiency of required skills within a population will be achieved to varying degrees of success (particularly related to developing and managing AI), to ensure that the economic opportunity from the application of generative AI can deliver widespread benefit will require the population to achieve some minimum level of digital literacy.

The COVID-19 pandemic became a catalyst to encourage greater digital adoption among Japanese businesses and the government, as well as to improve population digital literacy.[xxix] Japan ranked 29th in the 2022 World Digital Competitiveness Ranking, signaling that there may be room to improve in areas such as training and education.[xxx] Along these lines, research has found that among Japanese university students, digital literacy rates lag behind other developed countries, while its current ICT lesson structure would also lack opportunities for students to utilize and apply what they had learned.[xxxi] To better leverage the opportunities of generative AI, it will be imperative that students are exposed to digital literacy education across the K-12 curriculum as well as part of tertiary education, and that they are given the opportunities and the tools to apply these skills. Over the past two years, the Japanese government has made considerable effort to integrate ICT education in Japanese schools through its Global and Innovation Gateway for All (GIGA) School Program providing students with computer devices and high-speed communications networks to foster their digital competencies.[xxxii]

Furthermore, building upon digital literacy will be the need to improve digital fluency in AI—the ability to operate in an AI environment and leverage AI tools.[xxxiii] This includes learning how to manipulate and apply AI technologies across a range of situations and use functions to enhance existing work tasks for more effective and efficient results. This will require on-the-job training and industries to work with schools, universities, and vocational training institutions to ensure that curricula and syllabuses provide learners with job-ready skills for an AI environment.

5 Harnessing the potential of generative AI

Generative AI has the potential to create significant opportunities for the Japanese economy by revolutionizing the way in which work is currently done—by improving efficiency, increasing productivity, and supporting innovation. Anything that revolutionizes the production process has the potential to disrupt labor markets, particularly in the short-term. At the same time, how policymakers, businesses, and workers choose to anticipate and prepare for the revolution will determine how effectively its benefits can be harnessed to support more sustainable and inclusive economic growth.

Implementing generative AI with the aim of harnessing its potential to drive economic growth will require a comprehensive approach that addresses not only the technological aspects of generative AI, but also the social, economic, and ethical implications of the technology. A national vision, which includes a policy and regulatory framework, that encompasses these factors will be necessary to ensure that the benefits of generative AI are maximized. One of the key purposes of such a framework would be to provide clarity for businesses and other potential users of generative AI technologies on the policy and regulatory stance, as well as the guardrails that need to be put in place.

It may be necessary for policymakers to reimagine existing government policies and regulations and create new ones that are fit-for-purpose and adaptable—such as facilitating access and adoption and securing innovation—while guiding participants on responsible use. Businesses should consider investments to prepare its systems, processes, and people to make the most from generative AI's opportunities, as well as being cognizant of its potential risks. Furthermore, workers will need to be open to adjusting to the changing work environment, including by gaining new skills and engaging in lifelong learning.

The Japanese government has taken steps to develop AI-related regulations since 2019—underpinned by its Social Principles for Human-Centric AI—with an eye towards maximizing its benefits for society, and has continued to update the regulations as the technology, and our understanding of it, has evolved.[xxxiv] The Japanese Government formulated its "AI Strategy 2022" while maintaining the base of strategies and principles of the past.[xxxv] With the rise of generative AI, Japanese government's AI Strategy Council have reevaluated and restructured the issues and strategies in "Tentative Summary of AI Issues".[xxxvi] Given the broad-ranging impacts of generative AI, a coordinated effort is necessary to prepare for and enable the widespread use of generative AI. This will require collaboration across multiple stakeholders, from government, industry, academia, civil society, and the broader community to engage in the topics of how to best leverage generative AI and manage its risks.

The recommendations in this section are aligned with the direction of Japan's AI White Paper which acknowledges the promise of generative AI in driving productivity gains, reshaping work, and fundamentally altering socioeconomic systems, as long as the right regulatory harnesses are in place to capture its potential and manage its risks.[xxxvii]

Exhibit 9 presents a framework of 15 recommendations to drive generative AI use for consideration by government and business leaders, focused on three main policy objectives: (1) increasing access and adoption; (2) mitigating risks; and (3) inspiring innovation.

Two overarching principles should guide the approach to considering these recommendations:

1. Ensure coordination across government on generative AI policy and regulatory matters, such as through establishing a cooperation mechanism like the UK's Digital Regulatory Cooperation Forum.[xxxviii] Given the broad-based potential for generative AI to have applications across all industries, there will need to be alignment in the approaches taken by sector regulators towards applications of generative AI within their regulatory purview.

2. Ensure collaboration between the public and private sector on initiatives to support the responsible use of generative AI, in line with the Japanese government's "agile governance" process, with a view to maximizing the benefits for the country, including through hosting Public-Private Forums.[xxxix]

EXHIBIT 9
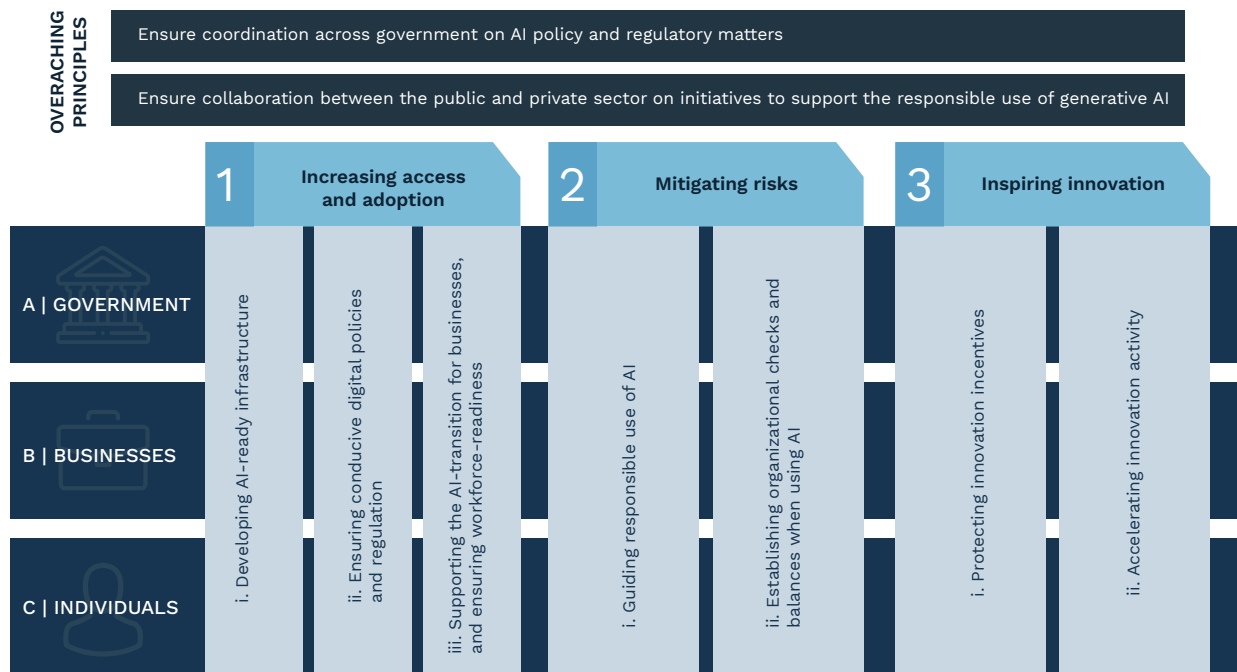
Source: Access Partnership

5.1 Increasing access and adoption

Government should have a coherent national vision that includes a fit-for-purpose policy and regulatory framework to guide the development and deployment of generative AI technologies to maximize its benefits for the country.

Developing AI-ready infrastructure

1. Government should review the current state of access to digital infrastructure and investments to improve access, with a focus on high speed broadband and hyperscale cloud.

2. Government should review households' access to digital tools, such as computers and the internet, and investments to improve access, with a focus on women, the elderly, populations in underserved communities as well as residing in rural areas.[xl] The full potential of generative AI for Japan will only be achieved through a wider effort to address the digital divide.

3. Government should conduct an assessment of the local generative AI ecosystem with a view to understand strengthens and potential gaps, including the availability of model and application developers, and service providers who can assist businesses with adopting generative AI technologies.

Ensuring conducive digital policies and regulations

4. Government should take stock of the national and local data ecosystems. Appropriate data protection frameworks that enable responsible data collection, management, and sharing will be a key driver of generative AI adoption.[xli]

5. Businesses should review their operations to ensure compliance with national privacy laws (Act on the Protection of Personal Information 2003) and existing guidance on data protection and data privacy (Guidebook on Corporate Governance for Privacy in Digital Transformation), which will enable generative AI models to process unstructured data while ensuring that personal data remains protected.[xlii, xliii]

Supporting the AI-transition for businesses, and ensuring workforce-readiness

6. Government should build on existing digital literacy programs and promote generative AI-specific skills through reskilling and upskilling initiatives aimed at different population segments including women, youths, mid/late-career workers, and the elderly to facilitate adoption and effective use of generative AI technologies and ensure a fair transition for workers at all levels.

7. Government should review initiatives to support MSMEs to identify the specific job roles and the tasks within these roles that would be affected by generative AI implementation. Based on this insight, job roles should be rescoped and relevant training could be offered to employees to improve labor market outcomes.

8. Governments should work closely with businesses to support workers to develop basic skills around learning, as well as social skills and management skills, which will continue to be an important part of a workers' toolkit.

5.2 Mitigating risks

The policy and regulatory framework within the national vision should consider the necessary guard rails needed to minimize risks and prevent the harmful use of the technology. Such guardrails should encompass national, sectoral, and organizational-level measures to guide the use and deployment of generative AI in a fair and safe manner that respects human rights and organizational values.

Guiding responsible use of AI

9. Businesses should review and adhere with national guidelines and consider implementing organizational-level AI governance frameworks with policy/standards for research and deployment that are aligned with the company's core mission and vision. This should build on global best practices (with a potential example being the NIST AI Risk Management Framework).[xliv]

Establishing organizational checks and balances when using AI

10. Government should consider initiatives to promote awareness of the importance of assessing risks of generative AI and support efforts of industry associations to develop guidance to businesses in the form of organizational roadmaps with risk management frameworks, with a focus on MSMEs.

11. Government should review support for MSMEs, with a view to considering support for conducting assessments for risk identification and prevention for especially high-risk generative AI applications.

12. Businesses should undertake risks assessments ahead of implementing generative AI, and proactively work to align their AI risk management framework with the organization's broader risk management efforts.

5.3 Inspiring innovation

Close collaboration will be required between government and the private sector to enable an innovative environment that ensures generative AI can fulfil its role as an accelerator of innovation.

Protecting innovation incentives

13. Government should review its broader innovation policy frameworks in the context of generative AI, with a view to achieving the right balance between adequate intellectual property protection and maintaining incentives for human innovation.

Accelerating innovation activity

14. Government should assess the innovation landscape to identify existing gaps and potential opportunities to promote research, development, and implementation of generative AI to foster an AI-ready culture at regional and national levels.

15. Governments, businesses, industry associations and community groups should collectively explore open data initiatives and Public Private Partnership (PPP) models to leverage diverse sets of data and knowledge to boost AI-enabled innovation.[xlv]

Appendix A: Methodology

The potential of generative AI is a ground-up estimation, comprising two related assessments of the expected effect of generative AI on: (1) the undertaking of specific work activities (i.e., tasks); and (2) the need for specific skills. The analysis starting with such a ground-up estimation reflects that generative AI will have implications for tasks within jobs. A limitation of the quantitative estimates is that it does not consider new jobs that could be created as generative AI becomes increasingly prevalent—that is, it only reflects the impact on existing types of jobs ("occupation").

The size of the reported impact of generative AI on jobs represents the share of tasks within a particular occupation that could be affected by implementation of generative AI. It does not reflect the number of jobs that will be replaced. It is likely that generative AI will change what tasks people focus on in their work rather than replacing entire occupations.

The determination of the skills most affected by generative AI is based on an assessment of the skills that are most prevalent (i.e., most frequently in use) among the tasks impacted by generative AI, how prevalent those tasks are among occupations, how prevalent those occupations are within industries, and the industry-structure of the country.

The analysis uses the following data sources:

- This analysis leverages O*Net data on tasks involved in all occupations, developed by the National Centre for O*Net Development. While the data are based on US surveys, it is expected that the types of tasks involved in an occupation should not materially differ between countries. That is, the tasks of a retail bank teller are the same whether it is based in the US or Japan.

- The analysis also leverages O*Net data on occupations related to the Work Context, including degree of automation; groupings of occupations by Job Zone, which is an assessment of the extent of preparation required; and its mapping of basic and cross-functional skills to occupations.

- The mapping of basic and cross-function skills to tasks, was developed by Access Partnership, was mapped at a detailed work activity-level.

- The mapping of occupations to industry is based on data by the US Bureau of Labor Statistics. The assumption is that the composition of the workforce by industry does not vary significantly between countries.

- The analysis of sector-level impacts by country uses data on workforce composition by sector from the UN International Labor Organization (ILO), and supplemented by data from national statistics offices where necessary.

- The analysis of production impacts by country uses data on gross output from Asian Development Bank, as well as employment data from the ILO and national statistics offices. This assumes that each task within an occupation in an industry has an equivalent value – which is proxied by a pro rata of gross output per worker within the relevant industry.

This analysis in this report provides an initial assessment of the potential economic impact of generative AI. It can provide a basis for future research to understand the broader implications of generative AI for economies, including in terms of gender, poverty, and regional dimensions.

The financial figures in this report are estimated in US dollars. Conversions, where applicable, are based on the average exchange rates in 2022 of 1 USD to 131.46 JPY.[13]

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[13]   Average exchange rate from 2022 obtained from https://www.exchangerates.org.uk/USD-JPY-spot-exchange-rates-history-2022.html

Appendix B: Disentangling generative AI from automation

Generative AI is not the same as automation. Previous research on the impact of digitalization on the workforce had a focus on the idea of automation, where the jobs most affected contained mostly routine tasks, and were generally in lower paid occupations.

It is expected that generative AI will transform tasks across a wide range of occupations, particularly occupations that involve tasks that are more complex. In these types of occupations, the use of generative AI is unlikely to supplant human participation—there will still need to be human judgement to account for algorithmic bias, as well as person-to-person interaction to manage important stakeholder relationships.

Used well, generative AI is not about replacing people in jobs. Instead, it is about supporting greater effectiveness and efficiency in their work tasks.

There are three findings that show how the impact of generative AI is different from automation, as it could transform: (1) non-routine work activities; (2) work activities that contribute to decision-making; and (3) occupations requiring greater preparation and demanding higher pay.

B.1 Generative AI holds potential for non-routine work activities

Generative AI is not expected to have the same workforce impact as digitalization. It holds potential for occupations that have a higher share of non-routine work activities, moving away from the idea of digitalization only affecting the most "automatable" jobs. For example, the job of a post-secondary school teacher is considered less automatable (that is, less routine), but they could benefit from the application of generative AI to support curriculum planning and delivering more personalized learning.

The occupations for which generative AI holds potential cuts across all occupations, including those assessed to have low degrees of automation (Exhibit B.1). That is, there does not appear to be a strong relationship between occupations with higher generative AI potential and their degree of automation.

EXHIBIT B.1

**Generative AI impact on occupations, by occupation degree of automation**
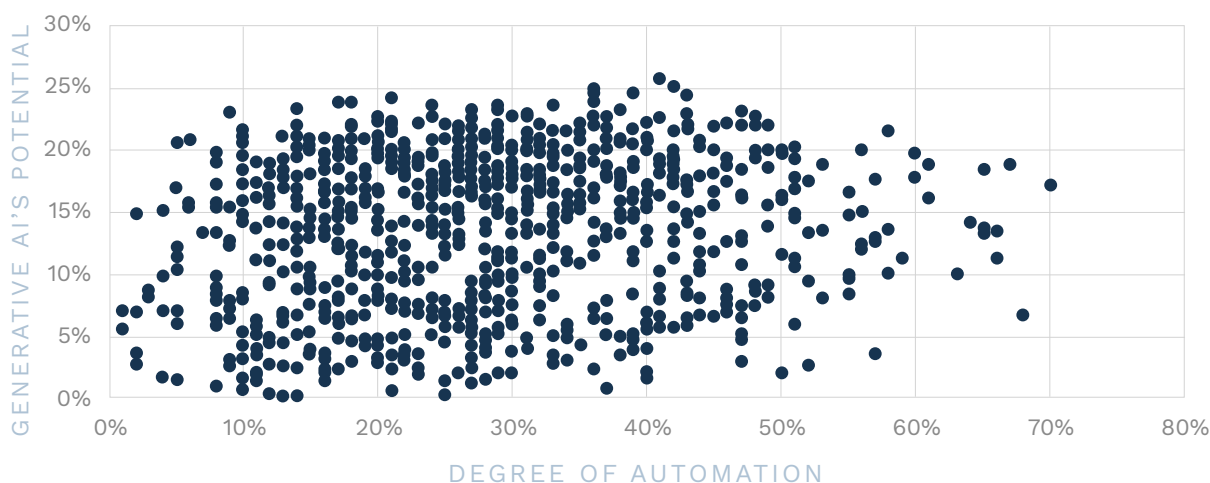
Notes: The analysis is done on a global level. n=873; each dot represents one occupation, e.g., investment fund manager. "Generative AI's potential" for each occupation is based on the share of work activities within each occupation that could be transformed by generative AI. "Degree of Automation" for each occupation is based on an assessment of occupations against a scale of being "not at all automated" to "completely automated", based on the O*Net Work Context data.
Sources: Access Partnership analysis, National Center for O*NET Development

B.2 Generative AI will transform work activities contributing to decision-making

Generative AI will be most transformative for work activities contributing to decision-making – those work activities related to monitoring and optimizing processes (e.g., work schedules), analyzing and processing large information (e.g., estimating and evaluating information and situations) (Exhibit B.2).

EXHIBIT B.2

Generative AI potential for work activities (z-score)

Generative AI Impact (z-score)
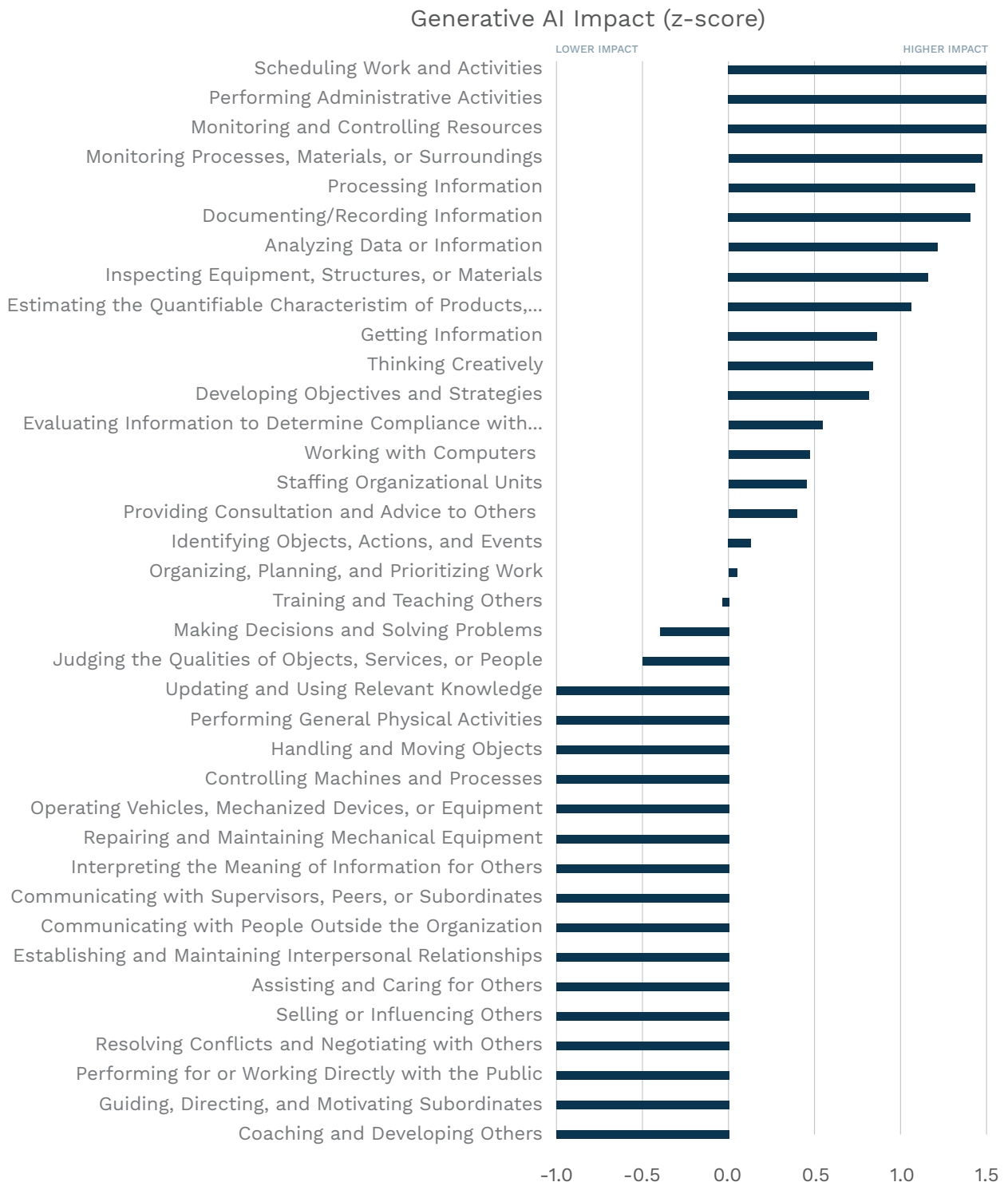
Notes: The analysis is done on a global level. "Generative AI impact" for each work activity is based is based on the share of sub-tasks within each work activities that could be transformed by generative AI.. The work activities listed are groupings of detailed work activities based on O*Net defined work activity elements. Z-score of greater than 0 represents an above average impact, while a z-score below 0 represents a below average impact.
Sources: Access Partnership analysis, National Center for O*NET Development

B.3 Generative AI will transform occupations demanding higher pay

Generative AI will transform occupations requiring greater preparation—that is, more years of education and training—and those demanding higher pay (Exhibit B.3). That is, there appears to be a positive relationship between occupations with higher generative AI potential and their pay level. For example, the job of a biologist is associated with considerable preparation and often higher pay, and they could benefit significantly from the use of generative AI to support their research and development efforts.

Again, this diverges from the impact of digitalization being attributed to highly automatable, and generally lower paid occupations that involve more routine tasks.

EXHIBIT B.3

Generative AI impact on occupations, by occupation pay level
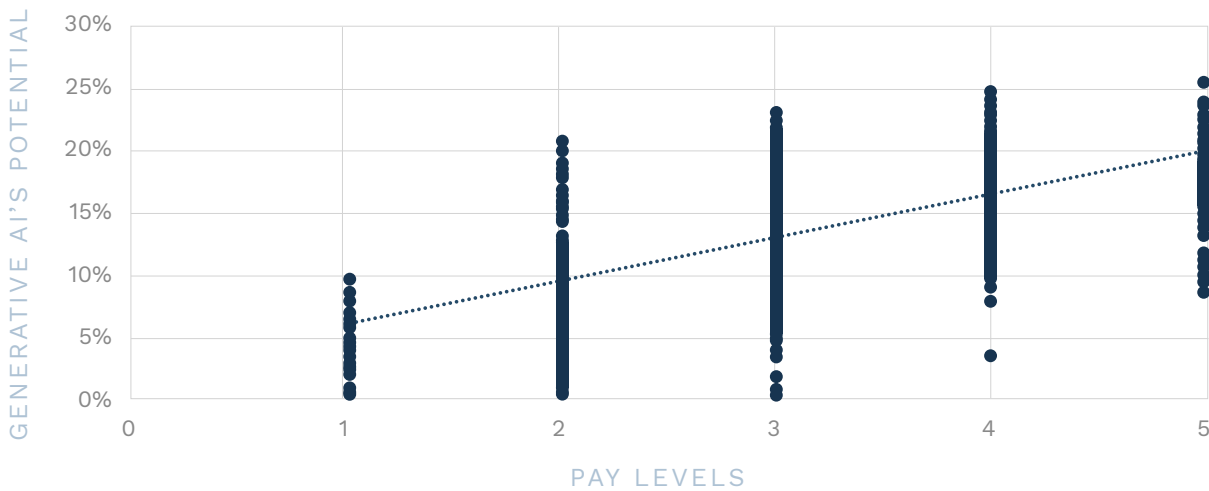
Notes: The analysis is done on a global level. n=873; each dot represents one occupation, e.g., investment fund manager. "Generative AI's potential" for each occupation is based on the share of work activities within each occupation that could be transformed by generative AI. "Pay Levels" is a grouping of occupations proxied according to the extent of preparation required for an occupation, based on the O*Net Job Zones data.
Sources: Access Partnership analysis, National Center for O*NET Development

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