



# Artificial Intelligence and the Future of Work in the Indonesian Public Sector

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## ABSTRACT

This study explores the adoption of Artificial Intelligence (AI) in the public sector, particularly how AI adoption affects employment and the future of work. The questions are what the correlation between AI and the future of work is and how the Indonesian government has developed strategies to adopt AI in the public sector. We sought data from various sources and found Indonesia's National Strategy on AI, published by the National Research and Innovation Agency (BRIN), to be the most relevant. We reviewed and discussed the paper by cross-referencing with the emerging studies on AI in the global context. We found a strong link between AI adoption and changing employment structure, which requires skills upgrades and human resource deployment restructure. Looking into the sectors more closely, we argue that AI adoption will dramatically change the nature of work and employment structure in healthcare and bureaucracy but will only moderately affect education, food security, mobility, and smart cities.

## 1. INTRODUCTION

Artificial intelligence (AI) is no longer a distant prospect in Indonesia. In November 2019, President Joko Widodo, ordered government agencies to replace several civil service positions with AI to create a leaner bureaucracy. Moreover, he has claimed on multiple occasions that "[Indonesia] is in a race with other countries to control AI. Whichever [country] controls AI, it can potentially control the world" (Wirajuda, 2021). The same standpoint has also been expressed by Indermit Gill, Senior Vice President for Development Economics of the World Bank, that any entity who master AI in 2030 will dominate the world until 20100 (Gill, 2020). This statement indicates the central role of AI in predicting one country's future on the global stage. Since 2018, over 50 countries representing 90% of the global gross domestic product (GDP) have announced their AI strategies. The common goal is to capture the opportunities from this advanced technology to inform governments in policymaking that maximises people's well-being (HolonIQ, 2020).

Governments worldwide are ready to seize the initiative by boosting their spending on AI. According to Accenture's 2019 survey, the majority (86%) of 300 public sector leaders in Europe said they are open to increasing or significantly increasing spending on AI in the future (Accenture, 2019). An International Data Corporation (IDC) report from September 2022 shows that global consumption of AI will achieve almost USD 118 billion in 2022 and reach beyond USD 300 billion in 2026 (IDC, 2022c). This spending includes software, hardware, and services for AI-centric systems. This global trend also happens to governments in the Asia-Pacific region. Spending on AI systems will double, from USD 20.6 billion in 2022 to USD 46.6 billion in 2026 (IDC, 2022b).

The IDC report identifies state and local governments as the second most significant investors in AI-based solutions. The report forecasts a compound annual growth rate of 25.2% in government spending from 2020 to 2025. The investment in AI will grow by around 24.8% (IDC, 2022a). As for Indonesia, the IDC reported that in Southeast Asia Indonesian private sector is at the top of AI adoption (24.6%), followed by Thailand at 17.1%, Singapore at 9.9%, and Malaysia at 8.1%.

AI can be utilized in various fields and boost economic development (Yu et al., 2022). The proven capacity to increase productivity, efficiency, and service delivery has precipitated significant investment in

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technology by the public and private sectors. According to a report by the (McKinsey Global Institute, 2018), by 2030, two thirds of private corporations might have adopted at least one type of AI technology; while nearly half of them will have fully adopted AI in the five categories (computer vision, natural language, virtual assistants, robotic process automation, and advanced machine learning), which could potentially add USD 13 trillion to the global economy. (Eloksari, 2020) found that AI implementation could contribute up to USD 366 billion to Indonesia's GDP by 2030. (EDBI & Kearney, 2020) surveyed AI users and interviewed both public and private sector representatives in major Southeast Asian countries (Singapore, Malaysia, Indonesia, Thailand, Vietnam, and the Philippines) to understand the economic impact of AI implementation. The report concluded that AI implementation could add USD 1 trillion to Southeast Asia's GDP by 2030.

Despite increasing research contributions on AI, exploration based on empirical analysis in state-owned sector is still short (Sousa et al., 2019). AI's application and impact have not been studied in depth (Valle-Cruz et al., 2020). This is an urgent gap to address because AI applications and its impacts, will require a practical framework initiation (Wirtz & Müller, 2019). Indonesia has vast opportunities to utilize AI because this technology has an extensive potential to increase productivity, efficiency, human resource development, and innovations in various sectors, such as finance, healthcare, education, agriculture, law, transportation and maritime. AI can help the Indonesian government provide answers for efficient infrastructure issues, provide effective social service delivery, plan high quality education, help the government develop effective social policies, safer digital market, and provide the best public services. In this case, Indonesia can learn from other countries which have adopted AI much more progressively. For example, the government of China laid their AI initiative 'New Generation AI Development Plan' in 2017 and defined AI as a new focus of the international economy, a new economic development engine, and a new opportunity for social development. It is related to their aims to become a world-leading level and world's primary centre of AI innovation and economic power (China AI Strategy, 2017). The UK has similar aims to China, which define AI as a mode with vast potential to improve their economy, enhance its citizens' well-being, revolutionize industries, and offer top quality public services, as well as "to remain an AI and science superpower fit for the next decade" (UK AI Strategy, 2021).

Therefore, this present paper's objective is investigating the link between AI and the future of work in the public sector. More specifically, this paper asks whether Indonesia is prepared to adopt AI in the public sector. To achieve these two objectives, we scrutinized various reports published by public and private research organizations like McKinsey and the IDC, as well as scholarly journal articles. Against this backdrop, we reviewed the Indonesian National AI Strategy 2020-2045 published by the Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi/BPPT as part of the National Research and Innovation Agency/BRIN). We argue that adopting AI in the public sector will dramatically change the future of work and the structure of civil servant employment in some areas but only moderately affect others. Moreover, these changes relate to Indonesia's strategies and plan to adopt AI into five public priority sectors.

The article proceeds in four sections. Following this introduction, Section 2 describes measures and analytical methods for content analysis. Section 3 presents the findings and discussions. Section 4 outlines the conclusions, limitations, and recommendations.

## 2. METHODS

The initial stage of this research was to survey the Indonesian government's available studies and policy plans on AI adoption, especially its utilization in the public sector. At this stage, we found the National Strategy on AI published by BRIN in 2020 to be the most suitable. Based on the national strategy on AI, Indonesian government focus on five sectors. The national strategy focuses on adopting AI in five priority sectors that meet certain prerequisites, such as available datasets for modelling. Also, these sectors have a strategic position nationally in parallel with other vital national planning, such as the National Medium-Term Development Planning (RPJMN) 2020-2024, a roadmap for achieving Indonesia 4.0, an Electronic Based Government System, and Indonesia One Data Regulation. Therefore, this paper identified the five priority sectors: health care, bureaucratic reform, education and research, food security, as well as mobility and smart city. Then, we discussed each sector by cross-referencing existing relevant studies at the global level. Through this comparison, we explored the relationship between AI and the future of work in the government services; and the extent to which Indonesia is prepared to adopt AI in the public sector.

### 3. RESULTS AND DISCUSSION

#### AI and the Future of Work

Technology has become a significant part of everyday life and significantly impacts people's lives. AI has been rapidly adopted worldwide (T. Chen et al., 2021; Goralski & Tan, 2020), as its use is increasingly critical in various sectors, such as marketing, banking, finance, agriculture, healthcare, security, space exploration, transport, chatbots to manufacturing, and social media to public services (Yigitcanlar & Cugurullo, 2020). (Agarwal, 2018) observes that flows of technology, such as the Internet, big data, machine learning, and artificial intelligence, are transforming human existence at an unprecedented pace and scale.

These technological advances in AI, including robotics, machine learning, augmentation, and automation, can create economic growth and other benefits. However, it will also result in significant disruptions of jobs and livelihoods that lead to a significant shift in workers. Automation is the process by which machines replace entirely human labor. Meanwhile, augmentation is a symbiotic relationship whereby humans work closely with machines to execute tasks. These new modes of production and performance will inevitably remove many routines and repetitive jobs handled by humans, leading to rapid demand for some types of jobs, eliminating others, and creating completely new roles in the process. (McKinsey Global Institute, 2017) predicts that automation will massively effect employment as AI and robotics change or replace some jobs while prompting the creation of others. The rapid adoption of automation is projected to displace around 400 to 800 million workers by 2030. Moreover, 75 to 375 million people worldwide may need competence upgrading and shifting occupations. The challenge will be ensuring a relevant skill base and supporting workers to transition into new jobs or fields. Countries that fail to manage this transition can expect to undergo rising unemployment and falling wages.

Jobs will be both created and destroyed. AI and automation technology can automate a significant number of skills. New jobs will be created rapidly, and changing jobs will become more common. Scholars have extensively studied this change in the nature of work. (Deming & Noray, 2020) found that technology profoundly affects labour markets and employers in fast-changing occupations, such as STEM (science, technology, engineering, and math) jobs, which consistently require new skills and render more traditional skills obsolete. (Sigelman et al., 2022) found that technology (such as AI) is a significant driver of occupational transformation and that the COVID-19 pandemic accelerated this process. Meanwhile, (Frey & Osborne, 2017) examined 702 details jobs to evaluate their probability of using a new methodology. They found that 47% of jobs are highly susceptible (over 70%) to computerization.

In 1929, John Maynard Keynes famously predicted that the rapid spread of automation technologies would bring 'technological unemployment' (quoted in (Acemoglu & Restrepo, 2020). (Acemoglu & Restrepo, 2018) found that paradoxically, automation reduces some types of employment while creating new tasks that increase employment. (Acemoglu & Autor, 2011) argued that technology augmentation exacerbated income inequality. However, the latest findings by (Acemoglu et al., 2022) suggest no link exists between AI exposure and employment or wages at the occupation or industry level. However, they found that AI-exposed establishments reduce their non-AI and overall hiring. This means that AI-powered algorithms substitute human skills and competence alteration is required for the remaining positions. We can, therefore, conclude that machines, computers, software, and automation gradually reduce the demand for human labor. These technological advancements increase productivity and result in more economic benefits but ultimately reduce the proportion of human labor, widening inequality.

The advent of the Industrial Revolution heralded the beginning of an era where rapid technological advancement replaced the limited capacity of human labor (Dwivedi et al., 2021). In recent publications, AI researchers claimed that AI dramatically differs from prior technologies in its latent reshaping of work and employment (Ford, 2015; Tegmark, 2017). (Müller & Bostrom, 2016) surveyed groups of AI experts and found a 50% chance that high-level machine intelligence will be developed around 2040–2050, rising to a nine in ten chance by 2075. Experts predicted that most of the system will use super intelligence before 2100, and some of them feel that this advancement might be 'bad' or 'extremely bad' for humanity. Nonetheless, there are a number of ethical and economic insecurity related with AI execution, such as potential occupations disappearance, negative effects on social interactions, cultural complications, sustainability, and rapid technological transformation (Pappas et al., 2018; Walz & Firth-Butterfield, 2019).

Furthermore, according to a report by (West & Allen, 2018), AI's diverse application in various sectors, like finance, national security, health care, criminal justice, transformation, and smart cities, shows how it has reshaped peoples' way of living. This change leads to problems surrounding AI, like its ethical, transparency, and legal liability. Measures to address this issue include more stakeholders' involvement from national to local levels in policymaking, regulation, education, and investment in AI. (Haenlein & Kaplan, 2019) argue for the necessity of regulation to reduce the degree of disruption AI is likely to have on employment trends. One suggestion is a requirement to use a certain amount of companies' profit

because of automation to train the workers for new positions that improbable be automated. Also, governments could develop regulations to restrict the extension of automation. However, the reality is that government administrations are barely keeping up with the fast advancement of AI and have generally failed to address AI regulation comprehensively, which is demonstrated by insufficient substantial administration and laws (Wirtz et al., 2020).

### **AI in Public Services**

There is a growing interest in using AI technologies to improve processes within governmental institutions, such as internal service delivery processes, policy-making mechanisms, and other areas of public services. However, the complexity of digital technology adoption, in general, and AI, in particular, has often been challenging for public administrations (Misuraca & van Noordt, 2020; van Noordt & Misuraca, 2022). AI is an effective tool to help solve the government's problem in technology adoption to deliver services and engage with the citizens. (Mehr, 2017) argued that AI could increase government efficiency to provide better services and improve citizens' engagement and service delivery. (T. Chen et al., 2021) added that the fast adoption of AI-based self-service technology (SST) has immense potential to enhance productivity and customers satisfaction, reduce service costs, and reduce human workloads because of the cost-effective systematic workflow. AI also provides a window for public officers to interact more with their citizens, thereby improving public services.

However, though there is a extensive study on AI, the discourse has so far been dominated by the private sector (J. C. Newman, 2020). Until now, public sector's adoption level is noticeably slower than in the private sector (Desouza et al., 2020; Fatima et al., 2020) with far less attention being paid to AI in the state-owned sector (Sun & Medaglia, 2019), (Gesck & Leyer, 2022; Radnor & Osborne, 2013; Schaefer et al., 2021). Additionally, the adoption needs several considerations because of the government's AI adaptation in the public sector often fall behind than private sector with profit orientation (Fatima et al., 2020) . Despite the increased adoption of AI systems, empirical analysis on AI in the public sector is still inadequate (Sousa et al., 2019). Furthermore, its application and impacts have not been thoroughly studied (Valle-Cruz et al., 2020). This limitation is a substantial gap, as the advancement of this technology in the public sector, applications, and results, need to be situated in a practical framework to enable its application (Wirtz & Müller, 2019),.

### **The Indonesia National Strategy on AI 2020-2045**

The Indonesian government has attempted to respond to the opportunities and challenges of AI by formulating a national strategy titled *Strategi Nasional Kecerdasan Artifisial Indonesia* or *Stranas KA Indonesia*. The strategy is Indonesian breakthrough breakthrough regarding AI implementation. The Head of the National Research and Innovation Agency (BRIN), Laksana Tri Handoko, launched the Indonesia National Strategy on AI 2020-2045 on 10 August 2020 (Asia Society Policy Institute, n.d.). The strategy embraces a positive perspective on the impact of AI on the Indonesian economy. Handoko has stated that this strategy is an endeavour by the Indonesian government to utilise AI to boost efficiency and effectiveness across a range of industries and to be used in a lineup of the strategic domain (Hani, 2021).

As the fourth most populous country in the world, rich with history, tradition, and a steadily growing economy, Indonesia is presented with numerous opportunities to utilize AI. It can increase prosperity by improving business productivity, smart human development investment, and boosting innovation in various sectors, such as investment, health, education, agriculture, defence, transportation, and aquatic resources. As a member of the G20, Indonesia also must adhere to an ethical approach to AI implementation by following G20 AI Principles, which are 1) inclusive growth, sustainable development, and well-being, 2) human-centered values and fairness, 3) transparency and explainability, and 4) robustness, security, and safety (BPPT, 2020).

The national strategy focuses on adopting AI in five priority sectors that meet certain prerequisites, such as available datasets for modelling. Also, these sectors have a strategic position nationally in parallel with other vital national planning, such as the National Medium-Term Development Planning (RPJMN) 2020-2024, a roadmap for achieving Indonesia 4.0, an Electronic Based Government System, and Indonesia One Data Regulation. Those five priority sectors are 1) health, 2) bureaucratic reform, 3) education and research, 4) food security, and 5) mobility and smart city (BPPT, 2020).

This paper examines how AI is adopted to the form of public services in Indonesia through the Indonesia National Strategy on AI as well as evaluates the potential benefits and drawbacks of job transformation from the employment point of view. AI and automation tend to reduce the need for human labour while transforming existing roles and generating new ones, shaping a new organisational structure of employment in the public sector. Consequently, the State Civil Apparatus (Aparatur Sipil Negara/ASN) will be the most affected by this policy as they shape most of the public services workforce. Stranas KA also

explicitly states that as part of bureaucratic reform and simplification, the government will eliminate two levels of organisational structure and replace them with AI, automation, and machine learning (ML), freeing civil servants' manual labour. This starts with the Ministry of State Apparatus Utilization and Bureaucratic Reform (Kementerian Pendayagunaan Aparatur Negara dan *Reformasi Birokrasi-MENPAN-RB*) Circular Letter No. 390 of 2019 about Strategic Plan for Bureaucratic Simplification in November 2019 that answers Jokowi's statement to replace civil servant with AI. Government administration offices from central to regional levels began to gradually implement this reform until the final result on 31 December 2021, when 75% of echelon IV and III have been transformed into expertise positions (*jabatan fungsional*).

Five public priority sectors are emphasised in this paper. The workforce is not uniform—some have significant implications, while others have a negligible impact.

### Healthcare

Based on the strategy, AI will assist *healthcare* technology (health-tech) with big data analysis and machine learning to succeed in the government goal for the 4Ps of health tech (predictive, preventive, personalised, and participative). This technology will support the development of *telemedicine*, which enables video or phone appointments between patients and their healthcare practitioners. These activities range from a simple consultation to complex health tech like telesurgery or remote surgery, where surgeons use robotic and wireless networking surgical tools on patients from afar. A significant barrier to the equitable provision of health care is the uneven distribution of health workers across the diverse archipelago of Indonesia. Most health workers, such as doctors, dentists, nurses, midwives, and pharmacists, are concentrated in the relatively more developed islands of Java and Sumatra. *Telemedicine can potentially lessen this inequality by providing health services to remote areas. Moreover*, AI innovation will also help to build healthcare dashboards like alert systems for the spreading of disease in the future, similar to the COVID-19 pandemic, and provide a map of healthcare facilities and medical personnel availability.

Furthermore, one of the healthcare system's main issues is the storage and securing of medical records. Therefore, there is a necessity to develop secure medical data. The combination of blockchain and AI-based security can be utilised to secure medical records. Data transactions based on smart contract blockchain can guarantee that each instance of change and access to medical records is always known and registered. This technology can also detect illegal efforts to hack into that sensitive data.

While healthcare professionals will always be needed in the future, their number as civil workers will dramatically decrease with AI adoption. All clerical and administrative manual tasks will be eliminated, and consequently, the jobs of the workers who used to execute them. The technology will also allow health workers to stay focused on their healthcare-related tasks as the sometimes-burdensome administrative tasks will already be under control. The government will be more interested in employing those with specific expertise, like surgeons, paediatrics, dentists, nutritionists, and many more. The greater demand for highly skilled and specialised health workers will motivate general practitioners to develop themselves further, transforming the health employment map.

In the global context, AI has been rapidly deployed in huge areas regarding software algorithms, hardware implementation, and applications (Rong et al., 2020). A structured literature review found that the adoption of AI is increasing in health services management, predictive medicine, patient data and diagnostics, and clinical decision-making (Secinaro et al., 2021). Although AI can execute medical functions identical or superior compared to a person, a recent study argues that no jobs have been eliminated by AI in the healthcare sector (Davenport & Kalakota, 2019).

### Bureaucratic Reform

In terms of employment transformation, bureaucratic reform is the area that has the greatest potential to dramatically change the shape of the civil servants' workforce. AI adoption has affected the general administrative role (*jabatan administrator*) most directly. It is now being transformed into expertise in every government office, from central to regional and local government. The Law No. 5 of 2014 on State Civil Apparatus (*Aparatur Sipil Negara/ASN*) referred to civil servants (*Pegawai Negeri Sipil/PNS*) and government employees with employment agreements or contracts (*Pegawai Pemerintah dengan Perjanjian Kerja/PPPK*). With the backing of presidential decree No. 95 of 2018 on the Government Electronic Based System (*Sistem Pemerintahan Berbasis Elektronik/SPBE*), AI adoption will eliminate two levels of bureaucracy whereby PNS in administration positions used to do manual work.

There are various AI adaptations in this area. The strategy proposed AI innovations in government administration services that improve service delivery, such as chatbots for public service. PNS, usually on the front desk, will be replaced by chatbots, which can be accessed continuously by the public, which is providing a more effective and efficient service for the people. A study in Indonesia found that bureaucratic

reform with the use of information and communication technology (ICT) proved to be more productive related to official electronic document (Apriyani & Jannah, 2022).

According to (Makasi et al., 2022), several types of a chatbot are available for public service delivery based on the service's complexity level. The right chatbot will enable successful public service delivery, lowering costs and reducing employee workloads. The next level is intelligent automation. Automation can be robotic machines or software like Robotic Process Automation (RPA) which aims to substitute human labour with automation (Aalst et al., 2018) to improve efficiency by impersonating employees' work, therefore lessening human's workload (Syed et al., 2020).

Additionally, AI means that the machine can learn and make predictions and decisions based on the data or past situations they have encountered. All clerical and administrative offices will be redundant because the AI software can imitate the manual job that was previously executed by humans. Examples of tasks that AI could easily replace include writing letters, filling out forms, copying and pasting data from one spreadsheet to another, and accessing many databases simultaneously faster and more accurately than humans. Reflecting on this, the more sophisticated the service provided by AI, the more significant the effect on positions that will be replaced, ultimately significantly reducing civil servant recruitment.

In the near future, citizens can use chatbots for various services, such as information assistance, direct entry to open public data, and direct citizen reports to government officials or officers. Chatbots could even enable the establishment of places where people can submit their forms and pay their bills and taxes. For example, the government is developing SIGNAL, a national digital SAMSAT (One-stop Administration Services Office), and an application to make it easier for citizens to pay motor vehicle taxes safely and efficiently. This application will reduce the human workforce in SAMSAT offices, thus shrinking civil servant employment.

In addition to AI adoption based on the strategy, AI-based software can also be used to select and evaluate government budgetary proposals. AI can detect inappropriate budget spikes and flows and prevent budget waste. In this case, the employment of civil servants, such as auditors that usually input, select, and evaluate budgetary data, will likely decline. AI intervention in the government fiscal system will stop monetary corruption because the machine cannot be manipulated and has no ulterior motive.

Furthermore, the government can also employ AI to identify its citizens using biometric recognition such as fingerprints, palm prints, retina, voice, signature, and among others. With big data analysis, the government can gather data from various sources like the Internet and social media to detect a societal trend toward government policy. This system will help the government to make better decisions.

### Education and Research

The manual and classroom-based way we deliver education from the lowest level to the highest almost practically has not changed since formal education was established millennia ago. While educational technology has continued to evolve, from traditional blackboards to whiteboards and manual projectors to digital projectors, we remain in the classroom. Teleconferencing had great potential for use within the education system, but the technological gap between educators and students made this adoption slow-paced. However, the advent of the COVID-19 pandemic has dramatically upended the education sector worldwide. The education system took a massive leap in technological advancement, though this was unevenly implemented. Now that those changes have occurred, the development of AI will undoubtedly reshape education systems more fundamentally.

Following the national strategy, AI adoption in education is a priority because learning is a basic human need. AI will transform the education system by focusing on the student towards precision learning. This education learning system considers several aspects, such as cognitive, affection, psycho-motoric, and general behaviour, using big data from students' digital footprint. AI will be implemented in education in several ways, such as intelligent online education, as we have done over the past two years. Teachers have changed their teaching methods from face-to-face meetings (offline) to virtual classes with a synchronous method. AI can help educators through its implementation into teaching material and then automation of assessments, grading systems, and student classification based on the assessment. Adaptive learning and assessment systems will be adopted, where AI-based software can collect personal information and predict student preferences. Furthermore, learning paths can be tailored to each individual by adapting to the learners' ability, whereby the level of material difficulty can be raised or lowered after evaluation.

Artificial intelligence-enhanced education continues to evolve with the most recent developments allowing for a more immersive experience through Virtual Reality (VR) and Augmented Reality (AR). Furthermore, AI offers learners a more immersive learning experience that aims to enhance their overall studying experience, mainly when used with other technologies, such as virtual reality, 3-D, gaming, and simulation. (L. Chen et al., 2020).

Transforming conventional learning systems to modern AI-enabled applications in education, such as precision learning, which is a student-based education system that utilize big data from students' digital footprint, will also change the employment market for educators. Similar to the situation facing health practitioners, teachers will always be required, but their prospects for assured employment as civil workers or ASN are being seriously disrupted. Since 2021, the government is no longer recruiting health practitioners and teachers as civil servants but instead contracted workers (*PPPK*) for a minimum of one year and a maximum of five years, with a chance to be re-contracted again if the government still requires their services. In other words, they are no longer ASN. This current trend will dramatically change the shape of ASN workforces, which are comprised of about 60% of education and healthcare workers. About 52% of Indonesian primary and secondary education teachers (Jayani, 2022) and 32% of postsecondary teachers are PNS (Directorate General of Higher Education, 2020).

Consequently, like the tendency shown in the health sector, there will be a need for more qualified teachers with specialized skills that can adapt to fast-changing educational technology in the future. In addition, since the government will only offer five-year contracts, working in private schools might feel more secure as they offer longer tenure. Thus, competition in the teaching labor market will also intensify. Although there are many indications that Indonesia still needs millions of teachers to serve its massive population, it does not mean securing a job will be easier. Still, whoever has more qualifications will have a higher chance of employment.

### Food Security

In the national strategy report, one vital insight into national food security is mapping the area prone to food insecurity. Some indicators of food security are the availability of food supply, access to food, and food utilization in each region. AI can provide an alert system for food shortages and what types of food needs to be present in the supply chain. It can also assist in setting a minimum floor on the availability of nine staple foods and others that can lead to food price inflation. AI can also provide recommendations on access and utilization of food by balancing supply and demand in each area. The government needs an extensive, robust data database called Life Cycle Inventory (LCI) to support AI implementation on food security. These big data will be used as a national food database that will help predict and solve issues in the food sector, such as availability, acceptability, affordability, accessibility, and sustainability. Combining AI and satellite imagery will help the government map each region to overcome food insecurity. AI can also be used to predict harvest food production in the future by using data history combined with other variables such as weather and climate. Further, AI can be used to detect new food pests to anticipate and predict crop failure.

Currently, Indonesia sits in 63<sup>rd</sup> position in the Global Food Security Index 2022 out of 113 countries, particularly low on sustainability and adaptation variables (The Economist Group, 2022). (Spanaki et al., 2022), in their study, suggest using AI as a solution to food security problems for sustainability issues. In addition, (How et al., 2020) propose simple and user-friendly AI-based probabilistic reasoning to food researchers and policymakers to perform research analysis and design better food security systems.

Regarding employment, AI adaptation in the food security sector tends to generate new tasks and jobs rather than reduce them. New skills will be needed to deploy AI programs and technology for better national food security. Therefore, the government will need more new job positions, ASN with specific qualification for this sector. Although the current workforce will still face a transformation of its roles and responsibilities as new technology is introduced, training for the new skills will be vital as long as the government steps in to meet the challenge.

### Mobility and Smart City

According to the national strategy, urbanization happens in most parts of the world. The number of people living in cities has been over 50%, almost 60%, since 2010 compared to rural areas. If the trend continues, almost 70% of the world's population will live in cities by 2050. The task of city management becomes more complicated as resources are very limited. All cities face the challenge of providing adequate infrastructure such as roads, buildings, hospitals, schools, markets, and traffic management for their growing populations. The solution to these issues is to utilize technology to implement the smart city concept. These technologies will help the cities to organise their resources more productively, thus increasing the quality of living increases.

The government will utilize AI for mobility in a smart city in several areas, such as traffic management. AI combined with the Internet of Things (IoT) will provide a more efficient way of mobilizing around the city. Integrated CCTV will deliver accurate traffic conditions and can be developed for other traffic operations, such as *Tilang Elektronik* (electronic ticket), dynamically-priced toll roads, parking

systems, etc. AI technology can also assist with sustainable waste management. Furthermore, it will enable more effective disaster risk management in regard to initial mapping and early warning systems as well as post-disaster operations to mitigate the damage from fires, earthquakes, floods, volcanic activity, and so on. Other areas that could benefit from AI are citizen information management and space and public facility management. Regarding employment, AI adaptation in mobility and the smart city sector is similar to the food security sector, which has the potential to widen employment opportunities rather than shrink them, lead to an open recruitment of ASN with specific expertise for this sector. AI has been implemented in smart city systems around the world, such as the usage of machine learning, big data, and AI (Allam & Dhunny, 2019; Ullah et al., 2020), early risk warning systems of fire hazards (Zhang et al., 2021), and energy sustainability (Chui et al., 2018). New jobs and tasks are also emerging, especially in STEM (science, technology, engineering, and mathematics) in this sector.

Based on our review of the five sectors above, we found that there will be significant reduction of ASN hiring healthcare, bureaucratic reform, and education and research sector. In contrast, there will be increasing hiring in food security and smart city sector. To sum up, the findings can be seen on the Table 1.

**Table 1.** The trend of employment transformation after AI adoption in five priority public sectors

Sectors	AI adoption	Job transformation	Trend on ASN	Upgrade skills
Healthcare	High	High	Reducing hiring	Yes
Bureaucratic reform	Moderate to high	Very high	Reducing hiring	Yes
Education and research	Moderate to high	Moderate	Reducing hiring	Yes
Food security	High	Low	Increasing hiring	Yes
Mobility and Smart City	High	Low	Increasing hiring	Yes

This paper explores how AI is related to the future of work and how Indonesian government plan to adopt AI in the public sector. In the literature, employment transformation, new job creation, job losses, and reskilling, have been a central discussion on the impact of AI adoption. This is due to the Industrial Revolution, where rapid technological advancement replaced the limited capacity of human labour (Dwivedi et al., 2021). McKinsey Global Institute (2017) predicts that automation will massively affect employment as AI and robotics will change or replace some jobs while prompting the creation of others. The rapid adoption of automation is projected to displace around 400 to 800 million workers by 2030. Moreover, Frey and Osborne (2017) found that 47% of jobs are highly susceptible (over 70%) to computerisation. Based on the most recent report by OECD, found that there is 27% of jobs are at the state of high-risk of automation. More specifically, AI is expected to have the most impact on highly skilled jobs in fields such as medicine, law and finance, which may lead to major disruptions in the job market. The report also added that OECD countries may face an AI revolution (OECD, 2023).

AI adoption has rapidly altered administrative and medical processes in the healthcare sector. A systematic review of 180 academic literature found that AI systems are superior to humans in accuracy, efficiency and timely execution of medical and related administrative processes (Ali et al., 2023). Although AI can execute medical functions identical or superior to a person, a recent study argues that AI has eliminated no jobs in the healthcare sector (Davenport & Kalakota, 2019). However, a study by Hazarika (2020) identified one of the implications of AI adoption in healthcare is on the labour market, which is an increment of demand for new skills. Education and training will be critical for low-skilled staff to match labour market demand. In bureaucratic reform, bureaucracy is often criticised for its infective and inefficient way of doing public service deliveries. Many governments have been transforming their bureaucracy with ICT implementation, including AI, to answer this critique. A study found that computing technologies such as AI transform public administration operations by enabling it and making it more efficient (J. Newman et al., 2022). However, a study by Bullock (2019) found that this shift would diminish traditional street-level bureaucrats, as the author argued that systems-level bureaucracy within AI would only recruit staff for data processing, managers, and staff in client interface department. Therefore, AI highly transforms the nature and structure of bureaucracies.

Several literatures have explored the wide-ranged adoption and application of AI in education (AIEd) in various forms (L. Chen et al., 2020; X. Chen et al., 2020, 2022; Ouyang & Jiao, 2021). Using AI-based platforms, teachers are no longer burdened with administrative and repetitive tasks, which positively affect the teachers and students, as the teachers can now focus on achieving high-quality of student's performance (L. Chen et al., 2020). Even more advanced application, several studies have been exploring the use of the robot as teachers substitute, particularly addressing the issue of teacher shortage. They argued that AI would shortly provide affection toward the student and the capability to run the classroom like humans (B. I. Edwards & Cheok, 2018; C. Edwards et al., 2018). Therefore, based on these studies, recruitment for teachers would significantly decrease.



Furthermore, there is a limited literature regarding AI adoption in food security and smart city sector, particularly AI's link to employment and the future of work in these sectors. However, a few studies have explored AI's challenges and futures in food security, such as the need for basic infrastructures and technical challenges of big data, AI, and blockchain implementation for food safety. This novel field will create more jobs, particular for those with expertise in this sector (Zhou et al., 2022). In addition, regarding to the food industry, workers' engagement to food safety culture regarding food safety management systems (FSMSs) can be achieved with AI integration. This system framework requires procedures, training, and monitoring (Kudashkina et al., 2022). Therefore, skill upgrades will be high in this sector. Furthermore, AI-based technologies in smart cities have been implemented globally and will get more intense (A. et al., 2022). Based on a few systematic reviews, a study by Rjab et. al. (2023) reveal that several challenges regarding AI adoption in smart cities, such as technology, environment and organisation, and the literature are primarily focused on its application on business efficiency, data analytics, education, energy, environmental sustainability, health, land use, security, transport, and urban management areas. However, there is lack of exploration regarding its risks, particularly its impacts on society (Yigitcanlar et al., 2020). This impact could be related to employment and the future of work, which can be an area for future research.

#### 4. CONCLUSION AND RECOMMENDATION

This study has shown the correlation between AI and the future work in the public sector; and evaluated Indonesia's prospects to adopt AI for public services. This research confirms a vital link connecting AI adoption to changes in future employment structure. AI adaptation will dramatically change the future of work and the structure of civil servant employment in some areas, such as healthcare and the civil service sector. Meanwhile, it will moderately affect others, such as the education sector, food security, and smart city. This study also reviews Indonesian national strategies through five public priority sectors. This research confirms that AI adoption in these sectors ranges from moderate to high levels of implementation. Therefore, in terms of employment, AI adoption will require skills upgrades in each sector. However, the trend of civil servant recruitment will vary. Healthcare, bureaucratic reform, and the education and research sector will experience a reduction in hiring; meanwhile, recruitment of civil servants will intensify in food security and smart city area. It should be noted that this analysis is subject to several limitations. Firstly, this research only assessed the national strategy from an employment perspective. A more comprehensive analysis from various perspectives might result in different findings. Secondly, this analysis only sees the future of work through strategies and plans. Thus, further research will be needed to evaluate this policy.

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#### 6. REFERENCES

- Ashwini, B. P., S., R. M., & Sumathi, R. (2022). Artificial Intelligence in Smart City Applications: An overview. *2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS)*, 986–993. <https://doi.org/10.1109/ICICCS53718.2022.9788152>
- Aalst, W. M. P. Van Der, Bichler, M., & Heinzl, A. (2018). Robotic Process Automation. *Business & Information Systems Engineering*, 60(4), 269–272. <https://doi.org/10.1007/s12599-018-0542-4>
- Accenture. (2019). *Transforming Public Service with AI: A GovTech Ecosystem Approach*.
- Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. *Handbook of Labor Economics*, 4(PART B), 1043–1171. [https://doi.org/10.1016/S0169-7218\(11\)02410-5](https://doi.org/10.1016/S0169-7218(11)02410-5)
- Acemoglu, D., Autor, D., Hazell, J., & Restrepo, P. (2022). Artificial Intelligence and Jobs: Evidence from Online Vacancies. *Journal of Labor Economics*, 40(April 2022), S293–S340. <https://doi.org/https://doi.org/10.1086/718327>
- Acemoglu, D., & Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. *American Economic Review*, 108(6), 1488–1542. <https://doi.org/10.1257/aer.20160696>

- Acemoglu, D., & Restrepo, P. (2020). Robots and Jobs: Evidence from US Labor Markets. *Journal of Political Economy*, 128(6), 2188–2244. <https://doi.org/10.1086/705716>
- Agarwal, P. K. (2018). Public Administration Challenges in the World of AI and Bots. *Public Administration Review*, 78(6), 917–921. <https://doi.org/10.1111/puar.12979>
- Ali, O., Abdelbaki, W., Shrestha, A., Elbasi, E., Alryalat, M. A. A., & Dwivedi, Y. K. (2023). A systematic literature review of artificial intelligence in the healthcare sector: Benefits, challenges, methodologies, and functionalities. *Journal of Innovation and Knowledge*, 8(1). <https://doi.org/10.1016/j.jik.2023.100333>
- Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, 89(November 2018), 80–91. <https://doi.org/10.1016/j.cities.2019.01.032>
- Apriyani, N., & Jannah, L. M. (2022). Manifestations of Bureaucratic Reform through the Electronic Service Manuscript System : A SWOT Analysis at the Directorate General of Vocational Education. *Journal of Governance and Public Policy*, 9(3), 195–210. <https://doi.org/10.18196/jgpp.v9i3.14298>
- Asia Society Policy Institute. (n.d.). *Indonesia Artificial Intelligence*. Asia Society Policy Institute. Retrieved December 8, 2022, from <https://asiasociety.org/policy-institute/raising-standards-data-ai-southeast-asia/ai/indonesia>
- BPPT. (2020). Strategi Nasional Kecerdasan Artifisial Indonesia 2020 - 2045. In *Badan Pengkajian dan Penerapan Teknologi*.
- Bullock, J. B. (2019). Artificial Intelligence, Discretion, and Bureaucracy. *American Review of Public Administration*, 49(7), 751–761. <https://doi.org/10.1177/0275074019856123>
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education : A Review. *IEEE Access*, 8. <https://doi.org/10.1109/ACCESS.2020.2988510>
- Chen, T., Guo, W., Gao, X., & Liang, Z. (2021). AI-based self-service technology in public service delivery: User experience and influencing factors. *Government Information Quarterly*, 38(4), 101520. <https://doi.org/10.1016/j.giq.2020.101520>
- Chen, X., Xie, H., Zou, D., & Hwang, G. J. (2020). Application and theory gaps during the rise of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, 1(August), 100002. <https://doi.org/10.1016/j.caeai.2020.100002>
- Chen, X., Zou, D., Xie, H., Cheng, G., Liu, C., Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). *International Forum of Educational Technology & Society Two Decades of Artificial Intelligence in Education Published by : International Forum of Educational Technology & Society Linked references are available on JSTOR for this article : Two Decades of A. 25(1), 28–47.*
- China AI Strategy. (2017). *New Generation AI Development Plan*.
- Chui, K. T., Lytras, M. D., & Visvizi, A. (2018). Energy Sustainability in Smart Cities: Artificial Intelligence, Smart Monitoring, and Optimization of Energy Consumption. *Energies*, 11(11), 1–20. <https://doi.org/10.3390/en11112869>
- Davenport, T., & Kalakota, R. (2019). The Potential for Artificial Intelligence in Healthcare. *Future Healthc Journal*, 6(2), 94–98. <https://doi.org/10.2139/ssrn.3525037>
- Deming, D. J., & Noray, K. (2020). Earnings Dynamics, Changing Job Skills, and STEM Careers. *Earnings Dynamics, Changing Job Skills, and STEM Careers*, 135(4), 1965–2005. <https://doi.org/https://doi.org/10.1093/qje/qjaa021>
- Desouza, K. C., Dawson, G. S., & Chenok, D. (2020). Designing, developing, and deploying artificial intelligence systems: Lessons from and for the public sector. *Business Horizons*, 63(2), 205–213. <https://doi.org/10.1016/j.bushor.2019.11.004>
- Directorate General of Higher Education. (2020). *Higher Education Statistic 2020*. Sekretaris Direktorat Jenderal Pendidikan Tinggi.
- Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavarasan, P. V., Janssen, M., Jones, P., Kar, A. K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., ... Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, 57(August 2019), 101994. <https://doi.org/10.1016/j.ijinfomgt.2019.08.002>
- EDBI, & Kearney. (2020). *Artificial intelligence could deliver a US\$1 trillion uplift to Southeast Asia's GDP by 2030*. <https://edbi.com/news/artificial-intelligence-could-deliver-a-us1-trillion-uplift-to-southeast-asias-gdp-by-2030/>
- Edwards, B. I., & Cheok, A. D. (2018). Why Not Robot Teachers: Artificial Intelligence for Addressing Teacher Shortage. *Applied Artificial Intelligence*, 32(4), 345–360. <https://doi.org/10.1080/08839514.2018.1464286>

- Edwards, C., Edwards, A., Spence, P. R., & Lin, X. (2018). I, teacher: using artificial intelligence (AI) and social robots in communication and instruction\*. *Communication Education*, 67(4), 473–480. <https://doi.org/10.1080/03634523.2018.1502459>
- Eloksari, E. A. (2020). *AI to bring in \$366b to Indonesia's GDP by 2030*. The Jakarta Post. <https://www.thejakartapost.com/news/2020/10/09/ai-to-bring-in-366b-to-indonesias-gdp-by-2030.html>
- Fatima, S., Desouza, K. C., & Dawson, G. S. (2020). National strategic artificial intelligence plans: A multi-dimensional analysis. *Economic Analysis and Policy*, 67, 178–194. <https://doi.org/10.1016/j.eap.2020.07.008>
- Ford, M. (2015). Rise of The Robots. In *Basic Books*. <https://doi.org/10.1049/tpe.1988.0044>
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114, 254–280. <https://doi.org/10.1016/j.techfore.2016.08.019>
- Gesk, T. S., & Leyer, M. (2022). Artificial intelligence in public services: When and why citizens accept its usage. *Government Information Quarterly*, 39(3), 101704. <https://doi.org/10.1016/j.giq.2022.101704>
- Gill, I. (2020). *Whoever leads in artificial intelligence in 2030 will rule the world until 2100*. Brookings. <https://www.brookings.edu/blog/future-development/2020/01/17/whoever-leads-in-artificial-intelligence-in-2030-will-rule-the-world-until-2100/>
- Goralski, M. A., & Tan, T. K. (2020). Artificial intelligence and sustainable development. *International Journal of Management Education*, 18(1). <https://doi.org/10.1016/j.ijme.2019.100330>
- Haenlein, M., & Kaplan, A. (2019). *A Brief History of Artificial Intelligence*: 5–14. <https://doi.org/10.1177/0008125619864925>
- Hani, A. (2021). *Indonesia Deploys Artificial Intelligence to Accelerate Economy and Digital Transformation*. OpenGov Asia. <https://opengovasia.com/indonesia-deploys-artificial-intelligence-to-accelerate-economy-and-digital-transformation/>
- Hazarika, I. (2020). Artificial intelligence: Opportunities and implications for the health workforce. *International Health*, 12(4), 241–245. <https://doi.org/10.1093/INTHEALTH/IHAA007>
- HolonIQ. (2020). *50 National AI Strategies - The 2020 AI Strategy Landscape*. HolonIQ. <https://www.holoniq.com/notes/50-national-ai-strategies-the-2020-ai-strategy-landscape>
- How, M., Chan, Y. J., & Cheah, S.-M. (2020). Predictive Insights for Improving the Resilience of Global Food Security Using Artificial Intelligence. *Sustainability*, 12(15), 6272. <https://doi.org/https://doi.org/10.3390/su12156272>
- IDC. (2022a). *Asia/Pacific\* Artificial Intelligence Spending to Reach \$32 Billion in 2025, Says IDC*. <https://www.idc.com/getdoc.jsp?containerId=prAP49010122>
- IDC. (2022b). *IDC: AI Spending Will Rise Over \$46 Billion by 2026 in Asia/Pacific*. International Data Corporation. <https://www.idc.com/getdoc.jsp?containerId=prAP49721022>
- IDC. (2022c). *Worldwide Spending on AI-Centric Systems Will Pass \$300 Billion by 2026, According to IDC*. International Data Corporation. <https://www.idc.com/getdoc.jsp?containerId=prUS49670322>
- Jayani, D. H. (2022). *52% Guru di Indonesia Berstatus PNS*. Databoks Katadata Media Network. [https://databoks.katadata.co.id/datapublish/2022/01/12/52-guru-di-indonesia-berstatus-pns#:~:text=Kementerian Pendidikan dan Kebudayaan \(Kemendikbud,guru di Indonesia berstatus PNS](https://databoks.katadata.co.id/datapublish/2022/01/12/52-guru-di-indonesia-berstatus-pns#:~:text=Kementerian Pendidikan dan Kebudayaan (Kemendikbud,guru di Indonesia berstatus PNS)
- Kudashkina, K., Corradini, M. G., Thirunathan, P., Yada, R. Y., & Fraser, E. D. G. (2022). Artificial Intelligence technology in food safety: A behavioral approach. *Trends in Food Science and Technology*, 123(February), 376–381. <https://doi.org/10.1016/j.tifs.2022.03.021>
- Makasi, T., Nili, A., Desouza, K. C., & Tate, M. (2022). A Typology of Chatbots in Public Service Delivery. *IEEE Software*, 39(3), 58–66. <https://doi.org/10.1109/MS.2021.3073674>
- McKinsey Global Institute. (2017). Jobs lost, jobs gained: Workforce transitions in a time of automation. In *McKinsey Global Institute* (Issue December).
- McKinsey Global Institute. (2018). Notes from the AI frontier: Modeling the impact of AI on the world economy. In *McKinsey Global Institute* (Issue September).
- Mehr, H. (2017). Artificial Intelligence for Citizen Services and Government. *Harvard Ash Center Technology & Democracy*, August, 1–16.
- Misuraca, G., & van Noordt, C. (2020). Overview of the use and impact of AI in public services in the EU. In *EU Science Hub*. <https://doi.org/10.2760/039619>
- Müller, V. C., & Bostrom, N. (2016). Future Progress in Artificial Intelligence: A Survey of Expert Opinion. *Fundamental Issues of Artificial Intelligence Pp 555–572*, 376.

- Newman, J. C. (2020). Decision Points in AI Governance. In *Center for Long-Term Cybersecurity (CLTC) White Paper Series*.
- Newman, J., Mintrom, M., & O'Neill, D. (2022). Digital technologies, artificial intelligence, and bureaucratic transformation. *Futures*, 136(December 2021), 102886. <https://doi.org/10.1016/j.futures.2021.102886>
- OECD. (2023). *OECD Employment Outlook 2023*. <https://doi.org/https://doi.org/https://doi.org/10.1787/08785bba-en>
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2(March). <https://doi.org/10.1016/j.caeai.2021.100020>
- Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., & Lekakos, G. (2018). towards digital transformation and sustainable societies. *Information Systems and E-Business Management*, 16(3), 479–491. <https://doi.org/10.1007/s10257-018-0377-z>
- Radnor, Z., & Osborne, S. P. (2013). Lean: A failed theory for public services? *Public Management Review*, 15(2), 265–287. <https://doi.org/10.1080/14719037.2012.748820>
- Rjab, A. Ben, Mellouli, S., & Corbett, J. (2023). Barriers to artificial intelligence adoption in smart cities: A systematic literature review and research agenda. *Government Information Quarterly*, 40(3), 101814. <https://doi.org/10.1016/j.giq.2023.101814>
- Rong, G., Mendez, A., Bou Assi, E., Zhao, B., & Sawan, M. (2020). Artificial Intelligence in Healthcare: Review and Prediction Case Studies. *Engineering*, 6(3), 291–301. <https://doi.org/10.1016/j.eng.2019.08.015>
- Schaefer, C., Lemmer, K., Kret, K. S., Ylinen, M., Mikalef, P., & Niehaves, B. (2021). Truth or dare? - How can we influence the adoption of artificial intelligence in municipalities? *Proceedings of the Annual Hawaii International Conference on System Sciences, 2020-Janua*, 2347–2356. <https://doi.org/10.24251/hicss.2021.286>
- Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V., & Biancone, P. (2021). The role of artificial intelligence in healthcare: a structured literature review. *BMC Medical Informatics and Decision Making*, 21(1), 1–23. <https://doi.org/10.1186/s12911-021-01488-9>
- Sigelman, M., Taska, B., O'kane, L., Nitschke, J., Strack, R., Baier, J., Breitling, F., & Kotsis, Á. (2022). *Shifting Skills, Moving Targets, and Remaking the Workforce. May*.
- Sousa, W. G. de, Melo, E. R. P. de, Bermejo, P. H. D. S., Farias, R. A. S., & Gomes, A. O. (2019). How and where is artificial intelligence in the public sector going? A literature review and research agenda. *Government Information Quarterly*, 36(4), 101392. <https://doi.org/10.1016/j.giq.2019.07.004>
- Spanaki, K., Karafili, E., Sivarajah, U., Despoudi, S., & Irani, Z. (2022). Artificial intelligence and food security: swarm intelligence of AgriTech drones for smart AgriFood operations. *Production Planning and Control*, 33(16), 1498–1516. <https://doi.org/10.1080/09537287.2021.1882688>
- Sun, T. Q., & Medaglia, R. (2019). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*, 36(2), 368–383. <https://doi.org/10.1016/j.giq.2018.09.008>
- Syed, R., Suriadi, S., Adams, M., Bandara, W., Leemans, S. J. J., Ouyang, C., Arthur, H. M., Weerd, I. Van De, Thandar, M., & Reijers, H. A. (2020). Computers in Industry Robotic Process Automation: Contemporary themes and challenges. *Computers in Industry*, 115, 103162. <https://doi.org/10.1016/j.compind.2019.103162>
- Tegmark, M. (2017). *Life 3.0 Being Human in the Age of Artificial Intelligence*.
- The Economist Group. (2022). Global Food Security Index (GFSI). In *The Economist Intelligence Unit*.
- UK AI Strategy. (2021). *National AI Strategy*.
- Ullah, Z., Al-turjman, F., Mostarda, L., & Gagliardi, R. (2020). Applications of Artificial Intelligence and Machine learning in smart cities. *Computer Communications*, 154(December 2019), 313–323. <https://doi.org/10.1016/j.comcom.2020.02.069>
- Valle-Cruz, D., Criado, J. I., Sandoval-Almazán, R., & Ruvalcaba-Gomez, E. A. (2020). Assessing the public policy-cycle framework in the age of artificial intelligence: From agenda-setting to policy evaluation. *Government Information Quarterly*, 37(4), 101509. <https://doi.org/10.1016/j.giq.2020.101509>
- van Noordt, C., & Misuraca, G. (2022). Artificial intelligence for the public sector: results of landscaping the use of AI in government across the European Union. *Government Information Quarterly*, 39(3), 101714. <https://doi.org/10.1016/j.giq.2022.101714>
- Walz, A., & Firth-Butterfield, K. (2019). IMPLEMENTING ETHICS INTO ARTIFICIAL INTELLIGENCE: A CONTRIBUTION, FROM A LEGAL PERSPECTIVE, TO THE DEVELOPMENT OF AN AI GOVERNANCE REGIME. *Duke Law and Technology Review*, 18(1), 176.
- West, D. M., & Allen, J. R. (2018). *How artificial intelligence is transforming the world*.

- Wirajuda, T. (2021). *President Jokowi Urges Indonesia to Accelerate AI Capabilities*. Kompas. <https://go.kompas.com/read/2021/03/09/062143674/president-jokowi-urges-indonesia-to-accelerate-ai-capabilities?page=all>
- Wirtz, B. W., & Müller, W. M. (2019). An integrated artificial intelligence framework for public management. *Public Management Review*, 21(7), 1076–1100. <https://doi.org/10.1080/14719037.2018.1549268>
- Wirtz, B. W., Weyerer, J. C., & Sturm, B. J. (2020). The Dark Sides of Artificial Intelligence: An Integrated AI Governance Framework for Public Administration. *International Journal of Public Administration*, 43(9), 818–829. <https://doi.org/10.1080/01900692.2020.1749851>
- Yigitcanlar, T., & Cugurullo, F. (2020). The sustainability of artificial intelligence: an urbanistic viewpoint from the lens of smart and sustainable cities. *Sustainability (Switzerland)*, 12(20), 1–24. <https://doi.org/10.3390/su12208548>
- Yigitcanlar, T., Desouza, K. C., Butler, L., & Roozkhosh, F. (2020). Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature. *Energies*, 13(6). <https://doi.org/10.3390/en13061473>
- Yu, Z., Liang, Z., & Xue, L. (2022). A data-driven global innovation system approach and the rise of China's artificial intelligence industry. *Regional Studies*, 56(4), 619–629. <https://doi.org/10.1080/00343404.2021.1954610>
- Zhang, Y., Geng, P., Sivaparthipan, C. B., & Muthu, B. A. (2021). Big data and artificial intelligence based early risk warning system of fire hazard for smart cities. *Sustainable Energy Technologies and Assessments*, 45(March), 100986. <https://doi.org/10.1016/j.seta.2020.100986>
- Zhou, Q., Zhang, H., & Wang, S. (2022). Artificial intelligence, big data, and blockchain in food safety. *International Journal of Food Engineering*, 18(1), 1–14. <https://doi.org/10.1515/ijfe-2021-0299>