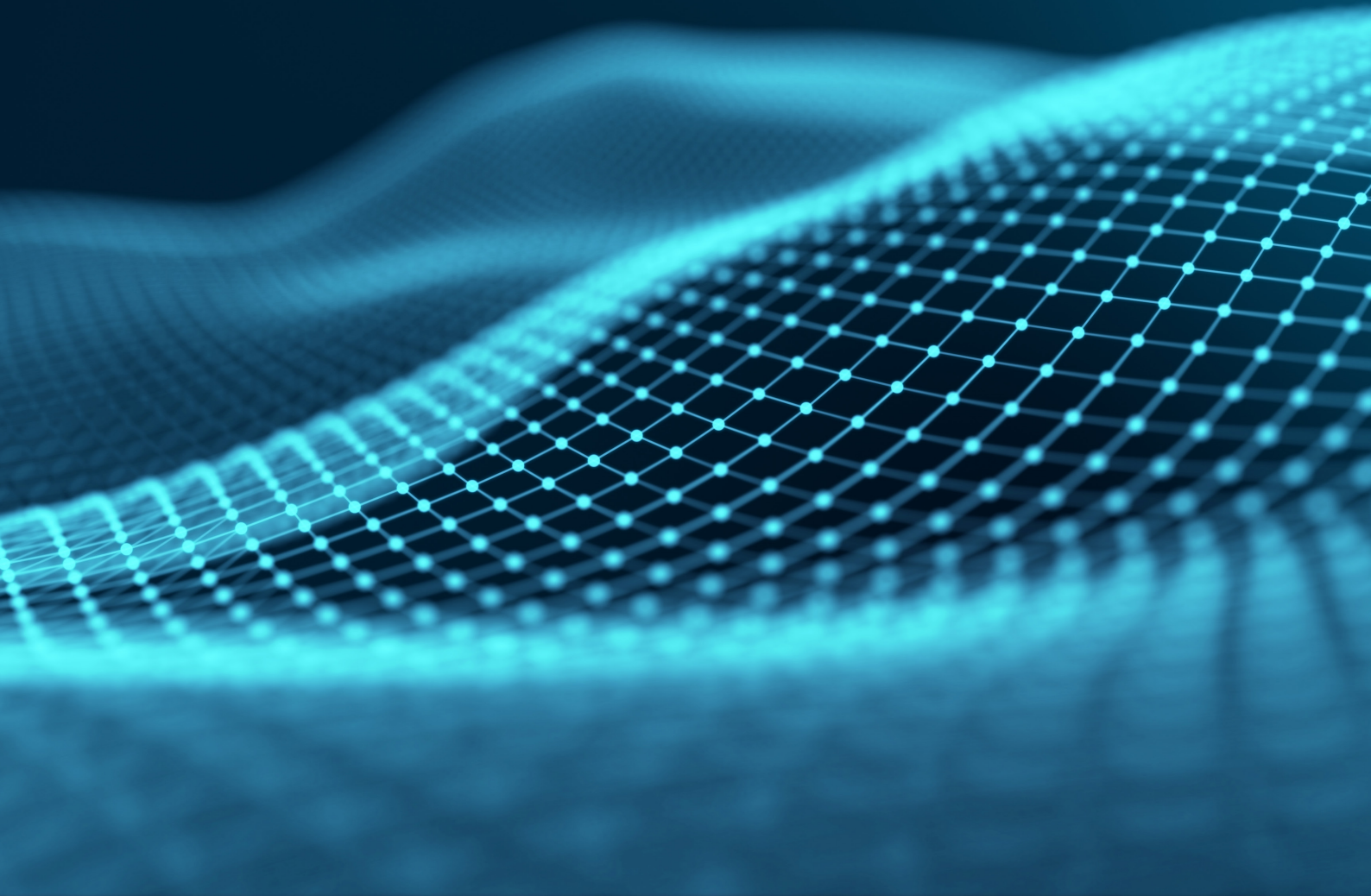




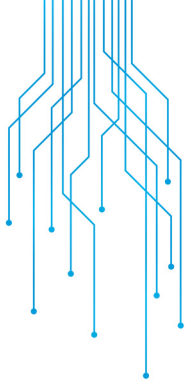
APEC Business Advisory Council

ARTIFICIAL INTELLIGENCE IN APEC

**Overview of the state of AI in APEC economies and
the enabling initiatives that will further drive adoption**



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Foreword

As chair of the APEC Business Advisory Council (ABAC) for 2020, it is my pleasure to present this report on artificial intelligence (AI) and APEC. This report, which is part of an initiative to raise the profile of AI on APEC's agenda, illustrates how AI-based technologies are being implemented across APEC economies to spur economic growth, address societal challenges, and solve critical business issues. It also sets forth several recommendations from ABAC on how APEC can bolster its role in addressing the policy implications of AI-based technologies.

ABAC serves as the official mechanism for private sector input for APEC and in this role, we strive to ensure that APEC's agenda remains forward-looking and responsive to new developments in the region's commercial environment and cross-border trade. AI technologies have the potential to significantly impact businesses and communities across our economies and we believe that APEC can serve as an effective forum for member economies to collaborate on ways to maximize the benefits of AI and promote inclusive growth while ensuring its use in a responsible and ethical manner.

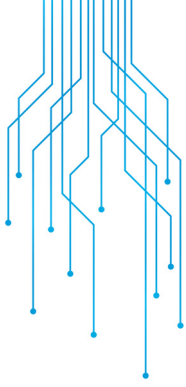
APEC boasts a long record of proactive engagement on policy issues surrounding emerging technologies. When Malaysia hosted APEC in 1998, ministers established the APEC Blueprint for Action on Electronic Commerce. In 2004, APEC created the APEC Privacy Framework which led to the development of the Cross Border Privacy Rules system. APEC has the opportunity to build on this record of success by taking a holistic approach to tackling policies around AI.

As we release this report, APEC economies are facing the twin threats of a global pandemic and an economic crisis that will leave its mark on our communities for years to come. The adoption of digital technologies, including those that leverage AI, have accelerated and they are playing a crucial role in enabling people to continue to go about their daily lives. We will also rely on them as we work to recover and restore economic growth. However, as we increase our dependence on digital technologies, we risk exacerbating the digital divide that existed before the pandemic.

How APEC economies address the accelerated rise of the digital economy and leverage new technologies like AI is one of the most pressing issues of our times.

Dato Rohana Tan Sri Mahmood
APEC Business Advisory Council (ABAC) Chair 2020





Acknowledgments

About ABAC

The APEC Business Advisory Council (ABAC) was created by the APEC Economic Leaders in November 1995 to provide advice on the implementation of the Osaka Action Agenda and on other specific business sector priorities, and to respond when the various APEC fora request information about business-related issues or to provide the business perspective on specific areas of cooperation.

ABAC comprises of up to three members of the private sector from each economy. ABAC members are appointed by their respective Leaders, and represent a range of business sectors, including small and medium enterprises. The economy determines the term of membership of each appointee as well as its own administrative arrangements and staff support

The ABAC International Secretariat based in Manila, the Philippines, serves all members and all economies and maintains a website. Funding is provided through a system of annual dues, which are structured to reflect the size of each economy, following the APEC formula.

For more information, visit www2.abaconline.org

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At Microsoft, our mission is to empower every person and every organization on the planet to achieve more. Our mission is grounded in both the world in which we live and the future we strive to create. Today, we live in a mobile-first, cloud-first world, and the transformation we are driving across our businesses is designed to enable Microsoft and our customers to thrive in this world.

We do business in 170 countries and are made up of 144,000 passionate employees dedicated to fulfilling our mission of helping every person and every organization to achieve more.

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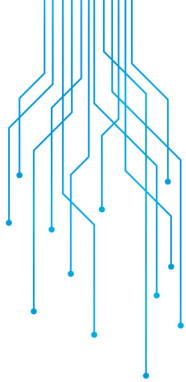
About TRPC

TRPC is a boutique consulting firm specializing in digital economy and digital trade developments throughout the Asia-Pacific region, and with a deep background in telecommunications and information technology, particularly the policy, regulatory, and economic impact issues.

TRPC offers specialized advisory, research, and consulting services, and possess an extensive network of industry experts and professionals throughout the region.

Recent work covers a broad swath of digital developments, including digital transformation, digital trade standards, real time payments and QR code system deployments, regulatory sandboxes and regtech models, cloud computing and network virtualization, data sharing, digital identity and trust frameworks, among others.

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Introduction

AI is ingrained in industry and is a rapidly emerging field across APEC economies

Artificial intelligence (AI) is the general term used for computing systems that emulate human cognitive functions, such as identifying patterns to solve problems. A catch-all term, often misused, AI comprises machine learning, deep learning, big-data analytics, augmented intelligence, automation, and some types of robotics – a range of methods for machines to mimic and expand upon a growing range of human mental processes.

Some forms of AI simply automate and optimize repetitive tasks. Many of these systems have already been integrated into various business processes and operations for quite some time, helping companies of all sizes increase efficiency and improve productivity. Other forms of AI can adapt and respond to contextual stimuli. These are used to provide analysis of vast amounts of data and output recommendations for human decisions. Such systems are rapidly becoming more available and more affordable due to the commoditization of cloud computing, mobile devices, and big data.

Many different implementations of AI are already beginning to transform the way companies, consumers, and communities transact and interact as businesses and other enterprises adopt AI to reduce costs, increase revenues, improve business efficiencies, or lead to new products or services – contributing to the dynamism in both mature and emerging economies. These facts belie a common misperception: that AI is something that is coming, or that will – in the future – have economic impact for companies, or for entire economies.

As this report demonstrates in detail, AI experimentation, innovation, and usage is already well established in every APEC member economy, across many key sectors, and encompassing all types of businesses and organizations – whether small, micro, or large; whether for profit or not-for-profit; whether public or private sector. AI has well and truly arrived, and APEC member economies would do well to work together to fully enable this next engine of economic and social growth.

AI is of growing importance to economic growth and regional trade in the APEC region

Many of the immediate potential productivity gains – enabling the automation of tasks, streamlining of processes, optimal allocation of resources – have been documented elsewhere, but this often fails to capture the richness and diversity in application and innovation, the potential for sustained and transformational economic growth, and the ability to create durable competitiveness by boosting employment opportunities and overall investment.

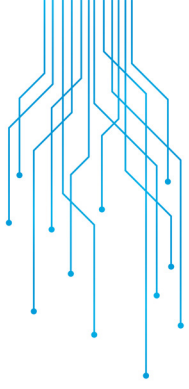
Beyond the economic benefits of AI, there is the potential to address a range of complex issues, including poverty, inequality, and climate change. And, as a number of the case studies in this report demonstrate, AI has a role to play in mitigating both the short- and long-term effects of the COVID-19 outbreak on APEC economies. From automated health diagnostics in hospitals to smart recruitment processes in companies, AI is creating new, previously unforeseen occupations, products, and services that will contribute to post-COVID-19 economic recovery. Given the innovative and transformative potential of AI, it is both urgent and necessary to

examine the ways in which AI business applications are already positively impacting key economic sectors in APEC economies, how this might best be learnt from, and what policies best enable such developments to emerge and grow.

About this report

Section 1 presents a landscape overview – a selection of case studies from APEC member economies showcasing AI in practice – to illustrate the variety of ways in which the public- and private-sector are developing or using AI in a range of activities, the impact that such innovation is already having, and what the future holds.

Section 2 uses the observations from the landscape overview to suggest policy areas that APEC member economies should consider addressing in order to create a supportive environment for regional AI opportunity, innovation, and growth. The section discusses fundamental issues that if addressed appropriately, would expand on the dynamism and diversity as AI is deployed and scaled and is already apparent across member economies. A brief set of summarized recommendations is provided for APEC leaders and economies to be able to harness and leverage AI.



Key Takeaways

Near-term measures APEC economies can implement to quickly and effectively harness AI

This report provides an indicative snapshot of the innovative artificial intelligence (AI) applications being developed and implemented across APEC economies. In the current environment, it is worth highlighting some of the areas in which AI could most immediately be employed to address some of the multiple disruptions the COVID-19 crisis is having on economies' dynamism and resilience.

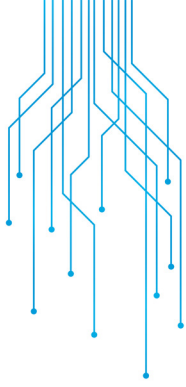
The most immediate measure APEC economies can take is to give active consideration to the **amplification or replication of a number of the AI-driven solutions presented in this report – or their various peers**. AI-enabled logistics systems, for instance, are used by online retailers to maximize productivity at a time of unprecedented demand. Drawing on the resources and expertise of global AI players, governments can drive and support the deployment of such systems beyond e-commerce vendors' warehousing needs; they can be used to streamline and rationalize all types of processes and operations along the supply chain in key sectors such as medical and healthcare, transport, and energy. Likewise, governments could broaden awareness of AI-based recruitment systems that make the remote and distanced screening of candidates both easier and fairer to all types of organizations, including the public sector. In the healthcare sector, AI-powered diagnostics can be extended to a wide range of applications, thereby improving the speed, responsiveness, and ultimately, care, that under-resourced and over-worked health systems are facing. Highlighting specific AI solutions that can save on labor or that can shorten or reinforce supply and distribution chains so that the benefits can be widely and immediately known would be of immediate benefit.

APEC economies should further consider accelerating the development of two important elements at the domestic level. First, strengthening **conducive business environments** that make it feasible and worthwhile to invest in and adapt business processes and practices to AI. This can be done by leveraging and encouraging cross-sectoral schemes that make it possible to share the cost and burden of deploying AI systems. A number of these are highlighted below and through the report. Second, by using the employment and re-inflation challenge we will all face to proactively enable **a workforce that is equipped with the skills and knowledge** to contribute to and benefit from the wider use of AI in the workplace. This can be done by incentivizing businesses' AI talent development and recruitment (training programs, upskilling schemes, progressive learning initiatives) –effectively addressing both the short-term need to get people back to work and the long-term objective of equipping them with new skills

At the regional level, APEC economies can take collective steps to ensure there is **a common appreciation of the value contribution that AI can drive in undergirding the region's renewed dynamism**. For instance, focused regional fora and dialogues on AI should be launched to share success stories and best practices specific to economies' AI implementation; economies that already have a domestic AI strategy in place can use such platforms to share their experiences with those planning their own AI-centric programs, opening the door to deeper discussions on the feasibility of multilateral AI frameworks between economic/trade partners.

In New Zealand, for example, Callaghan Innovation is helping the government put several of these steps into action. The organization provides access to incubator and accelerator programs for start-ups and legacy companies looking to digitalize, connecting them with sector-specific teams that can advise on everything from business modernization plans to the commercialization of complex technologies. In the current environment, Callaghan Innovation is also offering significant project grants, incentives, and loan schemes – often at very generous or on a concessionary basis – to help companies of all sizes embark on targeted R&D projects. Student Grants are also offered to connect companies to students with appropriate technical expertise, enabling these companies to develop bespoke R&D competencies while promoting workforce development.

Callaghan Innovation's initiatives present a cohesive model for the **coordinated mobilization of existing resources across sectors and industries, driven by the public sector but sustained by the private sector and enhanced by expertise derived from academia** and other expert bodies. A paradigm-shifting phenomenon that impacts all industries, AI requires similar efforts at cross-sectoral readiness. Similar organizations exist in a number of our economies. These should again be proactively focused on as potential lifelines for businesses ready to adapt and pivot as economies begin to grow again.



Section 1. Landscape Overview: AI Initiatives and Their Impact Across the APEC Region

Artificial Intelligence (AI) technologies are being integrated into the digitalization of private and public sector enterprise across APEC member economies. Companies of all sizes, from entrepreneurs to MSMEs and major industrial enterprises, are using AI to improve competitiveness by optimizing business processes, automating tasks, and reducing costs. AI is enabling businesses to offer new products and services, while enabling governments to improve both their own efficiencies and their service offerings to citizens. AI brings to bear the utility of vast amounts of data to help individuals in underserved or remote communities participate more fully in their economy. For example, by enabling small farmers to have the customized information they need to grow foods competitively in the marketplace, or by giving the hard-of-hearing ways to understand what is being said around them, enabling them to function more fully. AI is contributing to the lives, businesses, governments, and economic growth across APEC member economies.

1. AI Frameworks and Strategies

In addition to efficiency and productivity gains, AI is helping industry, academia, and government improve decision-making processes; from research to resource allocation, from investment decisions to talent recruitment, and in key sectors such as logistics, financial services, healthcare, and agriculture. In this context, a key question for governments should be how to best benefit their economy by creating the policy and regulatory environment to facilitate the development and use of AI while maintaining government oversight and mitigating unintended consequences or risks to society.

Benefiting from AI

As early as 2006, the **United Nations'** Millennium Development Goals Report officially noted that access to digital technologies was a determinant factor in equitable and sustainable economic development, and foresaw the forthcoming potential of data-driven innovations such as AI.¹ By 2016, the **World Economic Forum** (WEF) had incorporated this priority, placing AI high on its list of transformative technologies that economies should harness to remain relevant and competitive.² More recently, the **Pacific Economic Cooperation Council** (PECC)'s Vision for APEC 2040 puts industrial automation and AI among the 10 key priority areas that will drive innovation and competitiveness in APEC economies, as well as help the APEC region strengthen economic growth, development, and cooperation over the next two decades.³

While **APEC** has not yet adopted a position towards AI, there have been a number of sector-specific initiatives encompassing components of AI such as the APEC Framework on Human Resources Development in the Digital Age,⁴ the APEC SME Forum on Big Data and AI,⁵ and the APEC Framework for Securing the Digital Economy. There has not, however, been coordination amongst these initiatives.

That the time is right for such a mechanism to be put in place was illustrated in June 2019 when **G20** Trade and Digital Economy Ministers outlined economies' commitment to a human-

centered approach to AI, guided by a series of G20 AI Principles.⁶ The Principles have a non-binding nature and are drawn from the **OECD's** Recommendation on AI (adopted in May 2019), therefore underlining the need for inclusive growth, sustainable development and well-being, human-centered values and fairness, transparency and explainability, robustness, security and safety, and accountability. Also included are guidelines for policymakers in the areas of international cooperation, capacity building, and research and investments.⁷

Developing AI strategies

A majority of APEC member economies already have a plan, policy, or program specifically devoted to driving or supporting AI ecosystems. While their approaches differ, they generally strive to stimulate AI development to the benefit of their economy, while preparing society for the potential changes that may be brought about by AI (see Annex II for a summary of domestic approaches to AI):

- In the **People's Republic of China**, the Next Generation Artificial Intelligence Development Plan includes initiatives and goals for R&D, industrialization, talent development, education and skills acquisition, ethical norms, and security.⁸
- **Japan's** Artificial Intelligence Technology Strategy focuses on strengthening AI R&D capabilities, developing AI systems with industrial applications, and preparing workers for the transformations of the labor market.⁹
- **Mexico's** Towards an AI Strategy in Mexico: Harnessing the AI Revolution highlights some of the most pressing challenges as it designs an approach to AI governance, research, education, data, and ethics.¹⁰
- In **Singapore**, the AI Singapore program was launched to enhance AI capabilities, drive investment, and expand adoption.¹¹
- **Chinese Taipei's** AI Action Plan seeks to prioritize innovation and implementation as well as to develop software and hardware. The plan is guided by the principles of deregulation, open access, and technology investment.¹²
- In the **United States**, the American AI Initiative emphasizes R&D, training workers for a changing world, promoting trust, and using AI to protect domestic interests and values.¹³

APEC economies also have sector-specific initiatives aimed at upgrading existing industries with AI and increasing AI-focused collaboration across government, academia, and industry.

- **Chile** is preparing a draft AI policy to boost innovation in health, education, and manufacturing.¹⁴
- **Indonesia** launched an AI Strategy in August 2020 to accelerate AI development in five key sectors: healthcare, disaster preparedness, e-government, food security, and defense.¹⁵
- **Malaysia** is multiplying the number of joint experimental projects that draw on the expertise of global AI players in key sectors such as transport, logistics, oil and gas, and energy.¹⁶
- **Thailand's** AI initiatives are embedded within plans and policies developed by different ministries and agencies to bolster the development of data-driven technologies.¹⁷

Each of these efforts have several common themes, which are addressed more fully in Section 2, including: i) elevating AI in the economy's economic agenda; ii) building trust in AI; iii) providing a supportive policy framework for AI; and iv) preparing workers with the skills that are needed in the changing workplace. Some domestic approaches to AI also include measures to increase international cooperation and coordination in the field of AI, with a focus on leveraging multilateral platforms to make AI development and adoption as ethical and accountable as

possible.

Trust: Providing a framework for ethical AI

For the widest adoption of AI, people must have confidence they can trust the technology. Industry and governments recognize there is uncertainty as to how AI will reflect ethical values. Ethical AI development and responsible AI use have emerged as key concerns, particularly as more AI-enabled devices, platforms, and services leverage citizens' and consumers' data.¹⁸ Two regional frameworks stand out as notably influential in the way the discussion on ethical AI is being framed: the **European Commission's** Ethics Guidelines for Trustworthy Artificial Intelligence¹⁹ and the **OECD's** Principles on AI.²⁰ While their priorities differ, both frameworks aim to establish guiding principles by which AI can be developed and used in an explainable, fair, ethical manner with transparency and accountability.

At the trilateral level, APEC economies **Singapore, Chile, and New Zealand** signed the Digital Economy Partnership Agreement (DEPA) in June 2020, which promotes the adoption of ethical AI governance frameworks and aims to create consensus on governance and ethics principles in AI systems used across borders as part of one of the digital trade 'modules'.²¹ Other initiatives for designing and implementing ethics-related AI plans in APEC economies include:

- **Australia's** several government-led ethics frameworks²² and principles,²³ as well as proposed standards²⁴ for responsible AI.
- **Canada's** Advisory Council on Artificial Intelligence supports the commercial and industrial rise of AI while mitigating social, political, or ethical risks.²⁵
- **Singapore's** Advisory Council on the Ethical Use of AI and Data²⁶ has published documents on responsible data collection for AI adoption,²⁷ while the Monetary Authority of Singapore (MAS) has released its own fairness, ethics, accountability, and transparency (FEAT) principles to promote responsible AI in finance.²⁸
- The **Republic of Korea's** Mid to Long Term Master Plan in Preparation for the Intelligent Information Society is anchored on the concept of a human-centered intelligent information society,²⁹ and there are plans to develop a Charter of Ethics for developers and users of intelligent technologies.³⁰

While it is encouraging that APEC economies are recognizing the importance of AI and the need for enabling frameworks, a cursory review of the many plans immediately shows the diversity of expectations across the region and the many emerging requirements that governments are considering to put in place to ensure safe and secure development for their domestic communities. This again speaks to the timeliness for APEC to serve as a forum for coordination and regional cooperation – particularly given existing innovation and the growing business opportunities. Enabling such business opportunities to thrive should be borne in mind as policy frameworks are developed. The next section provides a snapshot of such business developments across APEC member economies.³¹

2. Innovative and Transformative AI for Economic Impact

Today AI is being applied to address immediate productivity, profitability and competitiveness challenges – reducing costs, resources, and uncertainties; streamlining processes and modernizing operations; enhancing logistics and optimizing supply chains; diversifying and dynamizing business models; improving predictions and decision-making; reaching new customers and accessing new markets; developing new services and products; and increasing workers' efficiency and satisfaction.

AI is also used to tackle more long-term issues that require complex, multi-layered solutions – reducing the cost of and the burden on healthcare; making the search for energy sources a clean and responsible process; enabling cooperation across languages, borders, and jurisdictions; and fostering innovation-driven environments in which AI no longer reacts to solve problems, but takes preemptive action before a problem actually emerges.

The case studies referenced here include businesses and organizations of all sizes and from all sectors, illustrating the diversity and range of opportunities for which entrepreneurs, MSMEs, start-ups, and multinational corporations are already leveraging AI in innovative and transformative ways (see Annex I for selected case studies from 14 APEC economies covering 10 different sectors).

AI for productivity, profitability, and competitiveness

AI is emerging as a viable and reliable way of streamlining processes and modernizing operations across a range of key industrial sectors. In Japan, digital technology continues to transform agriculture. NEC's **CropScope**, for example, improves the efficiency of farming and allows less experienced farmers to compete more effectively in the marketplace. CropScope automatically aggregates and analyzes sensor data and satellite images to provide tomato farmers with farm management recommendations. Five years in the making through a transnational proof-of-concept (POC), the system helps tomato growers leverage a wide range of data points on irrigation and soil and weather conditions to ensure that yields stay stable, while cultivation costs are lowered. In 2019 farmers in Portugal were able to achieve 30% higher yields than the average tomato farmer, using 20% less fertilizer. Small farms and co-operatives, and younger, less experienced farmers effectively substitute CropScope's analytical capabilities for the expertise of experienced farmers, lowering the entry barriers to environmentally sustainable agriculture. Enabling less experienced individuals to successfully enter farming potentially helps to ease the pressures of urbanization and in economies like Japan, where 60% of farmers are above the age of 65,³² provides a counter to the effects of an ageing population.

Logistics is another sector benefitting from AI's ability to analyze complex data at a speed and scale. Applying AI to optimize supply chain performance has been a key advantage for a number of online retailers in accelerating service to meet consumer demand. Chinese Taipei's online retailer **MOMO** uses its AI-powered **Smart Logistic System** that looks at demand factors such as product type and brand, consumption volumes and frequency, mapped against customer demographics and location, along with supply-side factors such as warehouse capacity, inventory levels, and vendor delivery schedules, to manage the stocking of the main warehouse and satellite warehouses (smaller facilities located closer to customer populations) with the right configuration of goods. The benefits of this are significant: more efficient, highly granular management of warehouse space, shorter overall delivery times, and a greater ability to fulfill express deliveries helps MOMO stay competitive in an increasingly saturated e-commerce market.

These benefits have proven especially invaluable during the COVID-19 crisis, where MOMO's Smart Logistic System allowed it to manage the unanticipated surge in demand for pandemic-related supplies. Despite February typically being a low season for e-commerce, large orders for toilet paper – which are bulky and tie up logistics capacity – began to overwhelm the e-commerce operator. Instead of allowing large volumes of toilet paper to occupy space in its main warehouse and slow the flow of other urgently needed pandemic-related products, MOMO's use of predictive AI enabled it to direct vendors to allocate supply directly to its satellite warehouses, which could then be quickly delivered to customers.³³ As evidenced in this case, the use of AI in logistic networks can increase the agility and efficiency of supply

chain management and provide companies in the context of broader economic dynamism with greater resilience.

As digital payments have become central to day-to-day life, and increasingly more personal data and transactions are processed, businesses' ability to keep customer data safe is constantly being challenged. To keep ahead of the challenges, AI now underpins some of the fastest, most effective and reliable automated fraud detection systems. Mastercard's **Safety Net** system is helping businesses of all sizes reduce the risk and the cost of credit card fraud. Fraud detection is at the core of Mastercard's operations as a company, and any failure in its internal systems is a monetary loss for Mastercard's issuing banks, and a blow to trust for Mastercard. There is an ongoing arms race between the various payments systems such as Mastercard and a host of criminals seeking to find vulnerabilities in these networks. Trained to automatically separate legitimate transactions from potentially fraudulent ones, Safety Net monitors the Mastercard network in real time, detecting suspicious transactions and blocking them. Mastercard experiences an average of 200 fraud attempts per minute. Between 2018 and 2020, Safety Net declined USD14 billion in fraudulent authorization attempts. In one instance, it detected a massive merchant spoofing attack and blocked USD26 million in fraud losses for issuers across several markets.

In a globalized digital economy, the rise of affordable and flexible online platform services makes it easier for companies to build standard features or capabilities (such as payments, chats, or online storage capacity) into their online products at very low cost. Entrepreneurs and start-ups can experiment and develop new services, SMEs can expand from local to global reach. Companies of any size can use these services to build scalable, solid foundations for the next generation of offerings that will drive their business' growth. For example, AI-driven chatbots and Live Chat systems are proving especially valuable for small businesses reaching new customers, allowing them to provide competent customer support in a cost-efficient manner. In Mexico, the AI platform **Yalochat** can interact with a business' customers almost as naturally and as intuitively as a human would, and this is transforming the way that businesses – particularly smaller businesses – are viewing their customer care and customer interaction options. Trained on the past experiences of customer service operators, with words, topics, and discussions, the system anticipates strings of questions based on speech content and patterns, and can make recommendations, suggesting solutions or products as appropriate. The inventive approach of the Yalochat system is that it does not rely on a business' own website (which may not be optimized for the purpose) but on the popular messaging platforms that customers already use (WhatsApp, for example).

The major advantage of leveraging existing messaging platforms is one of cost savings: a business does not have to build its own customer service platform (optimized website, mobile application, etc.). Another advantage is the ability to reach segments of the population who are not comfortable finding Internet support. The elderly, for example, may use WhatsApp to keep in touch with friends and family, but may not know how to search the Internet for practical information.

On that note, AI is also helping enterprises meet evolving customer expectations. For example, consumers have come to expect a personalized experience that anticipates their needs. Visa's **Travel Predict** is an AI-based recommendation engine that leverages transaction data to help issuing banks identify the credit and debit cards that are most likely to be used for travel and target appropriate travel marketing to those customers. Travel Predict collects and analyzes transactional data to generate scores reflecting the likelihood of travel in the next 30-90 days. Issuing banks use these scores, together with other information (such as the success of past

card promotions with a customer) to identify the best approach to reach customers with travel-related offers. For Visa issuing banks, AI helps identify with greater granularity the customers to market to and the appropriate type of marketing that will lead to greater card spending. This increases the efficiency and effectiveness of marketing, with banks using Travel Predict observing a 15% increase in overseas payments volumes per card.³⁴

Advanced recommendation engines such as Travel Predict offer a number of advantages for businesses in the consumer goods sector. First, they allow campaigns to be targeted with more specific understanding of individual customer needs without substantial research cost, making marketing smarter and more effective. Another major business advantage is customer satisfaction since anticipating a customer's needs plays an increasingly important role in long-term retention. Indeed, an exceptionally designed recommendation engine can be the underpinning of an entire business model. For example, it has been argued that the real value of Netflix lies not in its content library, but in its recommendation engine, which is effectively able to serve as a market research tool, marketing campaign platform and customer retention program.³⁵ Similarly, Amazon, eBay, and Alibaba have grown their businesses based on sophisticated recommendation and customer-insight engines

AI to solve complex challenges

In 2018, the Portrait of Edmond Belamy, an AI-generated painting, was sold at Christie's auction house for USD432,500.³⁶ Just a year later, the **Russian Direct Investment Fund (RDIF)** – Russia's sovereign wealth fund established to invest in companies in high-growth sectors and armed with a USD2 billion fund to invest in AI-related ventures³⁷ – co-organized an international art exhibition featuring artworks created entirely by AI. The event signaled the emergence of a highly promising market for AI-produced art, and brought to light the development of AI incorporating Generative Adversarial Network (GAN) algorithms that were used to create the artworks.³⁸ The Christie's auction and the Russian art exhibition demonstrate that AI used in experimental visual art has real market value. But also, these applications are at the forefront of AI innovation, demonstrating that AI can be creative. Such AI can be developed further to fit into other situations where creativity is expected from the technology. GANs are used in a wide range of creative applications, including video games (automated design of worlds and characters),³⁹ digital animation (streamlined processes for motion capture and special effects),⁴⁰ cinema (digitized actors),⁴¹ fashion (cost-effective generation of models and outfits),⁴² and aerospace (optimized aircraft and weather modelling, as well as generation of training simulations).⁴³

Such applications provide early indicators of how AI will advance to embody more human characteristics to improve how machines assist people to complete tasks with greater success, more efficiently and/or at lower cost. The profitable application of AI in these creative and artistic fields speaks to the applicability of these technologies to creative contexts in almost any industry. These advances in capabilities will lead to new products and services across sectors and applications, resulting in new business opportunities as they are developed.

In a more practical, immediate context, in Chile, where the unemployment rate is at a decade-high of 9% due to the COVID-19 crisis,⁴⁴ HR start-up **Genomawork** has developed an AI-driven system⁴⁵ that makes the recruitment and hiring process more efficient and less biased. By first analyzing a company's top performers in a selected role, the AI develops a set of performance indicators that are ideal for the position. Using data points collected from a series of online games developed specifically to assess their choices, actions and reactions, job candidates' behavioral and personality traits are then determined by the AI. These traits are mapped against the set of model performance indicators to complete the first stage of the screening process,

and successful candidates then proceed to a video interview. By automating the first stage of the candidate screening process, Genomawork helps companies reduce the hiring error rate by 25% (measured as new hires staying less than 3 months in their role). Erroneous hires carry costs amounting to 30% of an employee's annual salary, and thus reducing this rate helps companies achieve large savings in operational costs. As a result, the AI-driven approach not only reduces contracting and onboarding costs by an average of 25%, it also frees up time for hiring managers to devote to the final assessment of candidates.

Another benefit of using AI in hiring is the mitigation of inherent bias in the recruiting process. The act of evaluating people's capabilities is rife with explicit and implicit biases, whether selecting from hundreds of CVs or engaging in face-to-face interviews, there are many ways for recruiters to knowingly or unknowingly favor one candidate over another for the wrong reasons, making it difficult for an employer to know if a candidate is truly the best qualified for a job. Bias impacts a business' operational costs, contributing to opportunity losses by eliminating a potentially better-suited candidate, or one who's contribution may be diversifying a team's capabilities. With AI, recruiters can be aided by objective assessment of candidates' adequacy and help eliminate – or at least mitigate – the impact of bias. If harnessed properly, AI systems such as Genoma can become an invaluable asset for businesses looking for the right talent just as competition for jobs is set to rise in the post-COVID-19 economic recession.⁴⁶

A broader application of AI is the ability to input a very wide range of data points and produce useable analysis that can lead to better decision-making. One of the strengths of AI is the ability to help 'connect dots' and identify patterns of behavior or activity faster and more accurately than before.

In Peru, the geoglyphs of the Nasca region – a collection of colossal geometric figures representing living creatures and imaginary beings etched on the surface of the ground between 500 B.C. and A.D. 500⁴⁷ – have intrigued and baffled archaeologists since they were first studied nearly a century ago. To this day, their exact purpose remains unknown, but the Peruvian government and UNESCO have made it a priority to preserve these pieces of cultural and historical heritage.⁴⁸ The Nasca region is indeed going through rapid economic development as well as expansive urbanization, and it is not uncommon for heavy trucks to drive across the Nasca valley⁴⁹ or for local communities to build houses on top of protected sites.⁵⁰

For a team of archaeologists from **Yamagata University**,⁵¹ the best way to actively preserve the archaeological sites and to raise awareness among communities is to properly identify and map them. Using a purpose-built neural network that stitches together massive amounts of geospatial data – including geographical surveys, photos taken by drones, and satellite imagery – the AI produces high-fidelity maps that could not have been drawn at the same speed nor with the same accuracy. A machine learning algorithm is then applied to compare existing images of geoglyphs seen from above with new search areas, enabling the detection of visual patterns that may not have been discernible before. During its testing phase, the AI found a new glyph – a small humanoid figure – in an area that had been overlooked when previously explored. The discovery took only two months, as opposed to the several years that more manual methods had required, paving the way for similar discoveries that will reduce the time and cost spent mapping vast archaeological zones. Using AI to quickly and accurately map important areas will also help the Peruvian government reduce the funds it currently devotes to awareness campaigns, site reparation works, and patrolling the area.⁵² This increased speed, accuracy and efficiency enables smarter economic development of the region that preserves the unique history.

The speed, precision, and responsiveness with which AI systems make sense of immense amounts of unstructured geospatial data holds promise for many other sectors. In Papua New Guinea, oil and gas giant Total is making hydrocarbon surveying and exploration a fast, streamlined, and automated process that reduces the reliance on on-the-ground personnel and increases the reliability of collected information. Seismic data is collected using recorders that must be widely installed across a certain area. Installing these recorders evenly has been impossible in certain difficult terrain, which has resulted in survey data being incomplete or even erroneous. This has resulted in uncertainty over the viability of potentially promising sources of oil and gas, which has compromised plans to tap them, resulting in lost opportunities for extractors, and companies which may have resource deposits in inaccessible locations.

The **Multiphysics Exploration Technology Integrated System** (METIS) uses a fleet of autonomous drones to airdrop recorders that transmit seismic and topographic data in real-time.⁵³ The use of the technology enables Total to immediately assess the viability of a hydrocarbon source, completely avoiding the need to deploy heavy equipment and several highly trained people in potentially inhospitable conditions. A key feature of the system is the fact that the drones can autonomously conduct terrain assessments, determining the best time and location to deploy the topographic recorders. This not only reduces turnaround times, it also decreases the logistical needs of a new surveying mission in a new, unexplored zone.

For Papua New Guinea, the impact of the METIS system is largely related to mitigating the impact of surveying missions on its fauna, flora, and communities. First, the increased efficiency in the exploration process means there is less time spent in a given zone – from several weeks to just a few days. It also means less people and machinery deployed, which reduces the risk of trampling or damaging ecosystems. Second, AI-enabled precision-mapping enables targeted extraction processes, which translates into leaving as much terrain untouched and undamaged as possible. Third, all the equipment deployed has been designed to leave as little impact on the environment as possible; from the bioplastics used in the housing of the recorders to the biodegradable circuit boards that power them, investments have been made to develop eco-friendly surveying equipment.⁵⁴

Saving and transforming lives with AI

Timeliness and precision in data analysis are major challenges in the healthcare sector. By improving diagnostic tools with AI analysis, treatment can be offered earlier, improving outcomes, saving lives and reducing healthcare costs for individuals, businesses providing healthcare coverage, and for the healthcare systems across APEC member economies.

In the case of breast cancer, screening using X-rays (mammograms) is proven to reduce breast cancer mortality by up to 41%, but remains insufficient.⁵⁵ According to the World Health Organization (WHO), 627,000 women died from breast cancer globally in 2018 – which amounts to 15% of all cancer deaths among women.⁵⁶ In New Zealand alone, more than 600 women die of breast cancer every year, claiming the lives of about 70% of women who are diagnosed.⁵⁷ In this context, early and accurate diagnosis through quick and effective screenings are key to saving lives. On timing, mammograms are more widely available than just a decade ago, though many women are still diagnosed at an advanced stage of disease.⁵⁸ On accuracy, mammograms are vital for finding breast cancer, but 1 in 5 cases can be missed, as most radiologists still use 2D information (looking at X-rays) to assess a 3D phenomenon (potential cancer growth in breast tissue).⁵⁹

New Zealand's Volpara Solutions has developed the **VolparaDensity** system, which forms an additional layer of screening and complements traditional diagnostic methods, to improve the

accuracy of breast cancer detection, which in turn reduces the mortality risk and treatment costs of breast cancer. Breast tissue density is a major challenge for medical teams conducting breast screenings, as both cancer and dense breast tissue appear white on X-rays. Moreover, while dense breast tissue usually indicates higher risks of breast cancer, the human eye cannot accurately detect breast tissue density from a 2D X-ray. VolparaDensity applies a mix of computer vision and deep learning to analyze a mammogram, automatically estimating breast composition and assessing breast density by comparing a patient's mammogram scan with a database of 20 million other mammogram images. Using a number of pre-defined volumetric variables, the AI provides an indicative density score which is used to identify women who may either be immediately asked to conduct further tests or referred to a radiologist who can confirm the assessment.

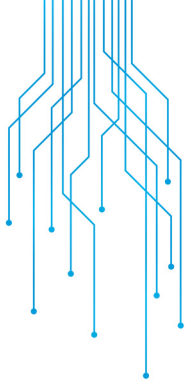
Computer vision and medical imaging analysis using AI are also being used to better diagnose and treat the SARS-CoV-2 virus in the People's Republic of China. Developed by Huawei, the **Patient Screening system for COVID-19** is an AI program specifically designed to recognize COVID-19 in CT scans of lungs. To create a database of images, doctors mark and label the tell-tale lesions caused by COVID-19-induced pneumonia in CT scans, providing the information that allows the algorithm to learn to identify and recognize similar patterns in other CT scans. The system has proven very effective in diagnosing the disease quickly – up to three days faster than manual methods – and far more accurately – with a 98% accuracy rate. Designed to adapt to the type of data it receives, the AI program can be fed new information on changing or evolving symptoms, allowing it to diagnose future mutations of the SARS-CoV-2 virus. Beyond the current COVID-19 crisis, the system could prove immensely useful in fighting other infectious diseases. The ability to adapt and deploy an existing AI system beyond its current applications also extends to Natural Language Processing (NLP).⁶⁰ Traditionally used to convert text to speech and vice versa, innovative forms of NLP can decode brain signals and turn them into both text and speech. This is especially impactful for patients suffering with locked-in syndrome (LIS), a rare neurological disorder that causes a severe paralysis of motor ability, including speech. A form of aphasia, LIS leaves patients unable to formulate language because of damage to specific brain regions.⁶¹ In many cases, the patients are fully conscious and aware of the world around them, but the only physical functionality they have left is the ability to blink or move their eyes in vertical motions – hence, they are 'locked inside' their own bodies.⁶² In the United Kingdom, former police officer Richard Marsh was 'locked in' after suffering a massive stroke; he was fully conscious and could hear everything around him, but could not protest doctors' suggestion to turn off his life support, which ultimately, they did not.⁶³

It is estimated that LIS affects about 1% of all people who have suffered a stroke. In the Philippines, strokes are the second leading cause of death,⁶⁴ representing close to 14% of all deaths in 2018 alone.⁶⁵ For this reason, LIS is a major health risk for the 35% of the total population suffering from some form of cardiovascular disease in the Philippines.⁶⁶ A prototype brain-computer typing interface developed by a team of engineers at the **University of Santo Tomas** in the Philippines could allow such patients to not only communicate, but regain their quality of life. The system records patients' brain signals when they are asked to imagine things like shapes and letters. The algorithm processes the signals and turns them into a personalized glossary that translates a specific signal into a specific shape, letter, or command – allowing patients to type by thinking.⁶⁷

Currently, physical therapy, nutritional support, and prevention of complications such as respiratory infections are often the only way LIS patients can be helped. Developed at scale, the AI-enabled brain-typing system could help those affected by LIS worldwide. It could, for instance, allow them to communicate with nurses or physical therapists to express the effects of

a given medication or exercise. They may also communicate with friends and family, improving quality of life, at a minimum by reducing the sense of loneliness and isolation which can lead to depression, and giving them the chance to recover at home and not in a hospital. If they are enabled to communicate their needs, there is a better chance that they will require less specialized support and resources. Indeed, while partial recovery of muscle control is possible – Richard Marsh himself recovered about 95% of his physical abilities.⁶⁸ Remarkably, he was ultimately able to resume his place in society.

As the case studies presented in this section show, AI is already helping address a range of challenges across the APEC region. In each case, along with society, businesses are benefiting by adopting the AI solutions – lower costs, greater efficiency along with better outcomes, or new or improved revenue streams. The economic impact of AI will be felt more broadly within and between APEC economies as AI matures and becomes more widely adopted. In light of the diverse range of AI systems and applications in APEC member economies, Section 2 explores some essential measures APEC decision-makers can undertake as they work towards making AI development and use an objective in plans for economic growth and development across the APEC region.



Section 2. Building Forward: Evidence-based Policies to Support Widespread AI Adoption

As demonstrated by the case studies in Section 1, a rich tapestry of innovative business models and practices are emerging thanks to AI. Though still in the early stages, AI products and services are being introduced across finance, healthcare, education, retail, logistics, manufacturing, agriculture, and government – strategic industries that together drive the economic dynamism of both emerging and mature APEC member economies. It is this type of evidence that should underpin any APEC position on AI and should inform the economic opportunity for business in APEC’s economic agenda and across APEC member economies.

To be sustainable, new technology will need to be trustworthy for businesses and consumers across multiple jurisdictions. A first step for APEC should be to look closely at what is already working in developing supportive frameworks to advance the use of AI in the region. Further, as with other cross-jurisdictional networked technologies (the Internet, cloud computing), a coherent regional approach based on international cooperation will ensure effective regulation and public policy is developed, which will in turn accelerate cost-effective, widely available AI adoption. Finally, there is strong evidence that the implementation of programs to prepare workforces (including students) with the necessary skills for changes in the market will directly contribute to expanded professional opportunities moving forward.

To address each of these areas effectively, it is important that APEC takes an evidence-based approach to policy positions for AI, as current implementations show that businesses are already using AI to advance economic opportunities.

1. Elevating AI in APEC’s Economic Agenda

As we have illustrated, AI is transforming businesses in practically every sector of APEC’s member economies – from agriculture to financial services, healthcare to logistics. AI is already improving the efficiencies of business operations and cost reductions, as well as enabling the development of new products and services. This creates the opportunity to access new markets, and to spur broad economic growth and development.

Commercial aviation as an industry, for example, has implemented different forms of AI to improve both front- and back-end operations. As with many other sectors, the crisis the aviation sector is now facing due to the COVID-19 pandemic will dramatically intensify the urgency of adopting advanced technology-based solutions that require less manpower and fewer resources but can still deliver services in a constant, reliable, safe and secure manner. There is already plenty of evidence to build from.

Since 2017, **Aeromexico** has used Yalochat’s AI chatbot to provide customers with services over WhatsApp and Facebook Messenger. Available 24/7, the platform automatically answers passengers’ queries and sends important notifications, providing on demand information in real time.⁶⁹ In 2019, **AirCanada** launched an in-house AI Laboratory to improve many aspects of air

travel including maintenance and downtime, customer experience and operational performance. One key solution is a predictive maintenance model that allows technicians to use vast amounts of data to plan and schedule the maintenance of components before they show signs of wear, thus reducing aircraft downtime and improving cost efficiencies. Recognizing the potential for cost savings, operational efficiencies, and improved safety, the airline has integrated AI as a fundamental part of its strategic roadmap.⁷⁰

In Singapore, the **Defense Science and Technology Agency** (DTSA) has started using machine vision and AI analysis of images and videos to optimize the maintenance, repair, and overhaul (MRO) for key engine parts.⁷¹ More recently, airports in the People's Republic of China have increased the use of AI systems to expand on-demand mobile services and automate passengers' self-service experience.⁷² As these examples show, AI is already improving aviation industry efficiency and reducing costs while also improving safety and the passenger experience.

If recent estimates published by the International Air Transport Association (IATA) are any indication, this is a critical time for such benefits to be more widely harnessed. The COVID-19 crisis is expected to cause global airline passenger revenues to drop by 55% in 2020 auguring a severe impact on businesses across the aviation sector.⁷³ This of course is far from an isolated example, with the effects of the pandemic threatening a widespread and major economic recession.⁷⁴ Although this is just one sector as an example; the case studies in Section 1 further illustrate that similar impactful developments can be seen sector by sector across the region – with the potential for deep and sustained transformation already apparent. In this context, it is essential, not least for domestic and regional economic growth, that businesses are able to seize the opportunities created by AI.

To achieve and sustain the benefits of AI and to weather the ongoing challenges, ABAC recommends APEC member economies elevate AI as a key priority in their economic agendas by creating conducive and actionable frameworks, launching enabling policies, supporting existing initiatives, and strengthening cross-sectoral and cross-institutional coherence and coordination.

2. Building Trust in AI

For AI to be accepted widely, people need to be comfortable with its use. Developing data-driven innovations such as AI in a safe, ethical, and trustworthy manner is necessary to gain citizens' willingness to use AI or AI-driven products and services. Businesses have embarked down this path and governments are beginning to look at these issues, and in some cases, develop policy guidelines for AI implementations. Working together, businesses and governments can help achieve a level of comfort for users, and those subject to the use of AI.

To take an example cited in Section 1, Mastercard's **Safety Net** system builds in an important security feature that ensures that safety and ethical principles are respected. The system is trained to perform observations and calculations such that fraud-detection can be done without human intervention. Fraud detection historically has relied on credit card fraud experts looking at customer data patterns for anomalous transactions. One key objective for Safety Net is to enhance data privacy and data protection by eliminating human access to the masses of data, enhancing security and improving trust. To take another example, since Visa's **Travel Predict** recommendation system uses financial data, it was designed to comply with the Monetary Authority of Singapore (MAS) and Personal Data Protection Commission (PDPC) guidance documents that require decisions made by AI are made in a transparent, fair and explainable

manner.⁷⁵ Given recommendations by the AI can potentially impact a customer's financial decisions, Visa's program employs a 'human-over-the-loop' approach which the PDPC defines as one that allows humans to take over decision-making when the AI encounters unexpected scenarios, ensuring greater transparency and fairness for the customer.

In the recruitment sector, **Genomawork** has two key objectives in using AI to evaluate job candidates on the skills specific to the needs of an employer. First, to reduce costs for the employer by making the match with candidates more immediate and more effective, and second, to make recruitment fairer and less biased – identifying the best qualified candidate on the basis of *skills and abilities*, rather than relying on CVs with unverifiable information, or risking the bias (unintended or not) of a HR executive. Notably, job applicants give the Genomawork system a 92% satisfaction rating even when not selected for the job, suggesting that fairness is enhanced in the process, in addition to the benefits the company enjoyed in identifying the most qualified worker with greater efficiency.

As these examples demonstrate, principles of fairness, ethics, and accountability are being incorporated into the development and use of AI systems across the APEC region. What should be recognized is that earning consumers' and organizations' trust in AI goes beyond developing principles and guidelines. Trust in AI requires AI solutions to be implemented in a trustworthy manner. As such, in designing effective frameworks APEC member economies are strongly advised to look at what is already working and develop policies from there.

To support industry's efforts to achieve greater AI adoption, governments can develop principles to guide ethical, accountable development and use of AI, giving developers a framework to work within. As an example, there may be a principle to require AI be 'explainable'. For instance, when an AI application is supporting decisions as to who qualifies for a loan, it is important for the bank to be able to explain the algorithm's recommendation and how the decision was made. A principle of 'accountability' would also apply, that the company takes full responsibility in case of errors, oversights, or systemic flaws. Generally, along with explainability and accountability, AI principles, whether government or industry, typically include setting objectives that ensure AI implementations are fair, transparent and without bias (or recognize bias and adjust for it). In setting out a principles-based framework with appropriate criteria, governments will aid businesses in aligning the use of AI with the public's expectations based on an understanding of the framework, thereby enhancing trust.

To further help build trust, governments can appropriately revise regulations and data protection requirements to better align with AI innovation. In many economies, privacy, data protection, and cybersecurity laws (where they exist) were enacted before AI, the Internet of Things (IoT), and big data analytics were a concern. These laws were aimed at protecting data collected through text inputs, for specified purposes, by a user on a web browser and typically stored and processed on a computer located within a business' premises. In the context of AI, vast amounts of data are collected from a wide range of inputs, and are aggregated and processed in big datasets to develop the behavioral models and profiles that power predictive algorithms. With this model, it is often difficult to comply with the traditional laws without incurring high compliance costs and impairing developers' ability to maximize the utility of the data to provide the most useful services to businesses and consumers. Thus, along with developing principles for AI development, governments across APEC should review and update their laws to enable AI innovation while continuing to protect the public interest.

3. Introducing Supportive Policy Frameworks for AI

Governments can have a major role in developing enabling AI ecosystems by expanding access to broadband, investing in research and innovation, focusing on government use of AI and open access to government data, and actively supporting the work of entrepreneurs, start-ups, research laboratories, and academics.

There are two major steps a government can take to directly to advance AI adoption. The first is to encourage and enable government procurement to embrace the capabilities of AI to improve the operations of government and the provision of services to the public. The second is to provide open access to public sector data to those developing AI so that the data can (a) be put to greater use benefitting the public, and (b) the benefits of accessing openly accessible pools of data become better understood and appreciated. Investing in R&D, when combined with policies to protect intellectual property, create the right environment for AI innovators to be able to grow research into commercialization and find a market for their product or service. The People's Republic of China,⁷⁶ Singapore,⁷⁷ and the Republic of Korea⁷⁸ are investing heavily in building AI ecosystems in which AI-driven companies and their innovative business models can grow and mature. In Indonesia,⁷⁹ Malaysia,⁸⁰ and Thailand,⁸¹ numerous public-private initiatives have begun taking shape to support experimental AI projects that go beyond for-profit uses of AI.

Broadband access is essential to ensuring the benefits of AI-based products and services reach the widest population. As illustrated in Section 1, AI is being used to bring the ability to successfully farm to individuals previously without significant experience, and therein making small holding farming more sustainable and scalable. Other AI driven technologies will similarly improve the lives of individuals living in remote or underserved communities. Further, with new workforce needs, these communities will benefit from online training and access to broad educational resources. For AI to be able to fully and equitably impact the economy it is necessary to universally improve connectivity and access to digital platforms.

In Peru, engineer Leoncio Huamán Peredo has developed '**Vision D**', an AI-enabled pair of glasses that translates speech into text displayed in real time as subtitles, allowing the hearing impaired to read the words spoken.⁸² Imagined in 2015, the invention was only able to be prototyped in 2020, when the speech-to-text capabilities became adequately fast and accurate.⁸³ Brought to market, such a system stands to transform the lives of more than 466 million hearing impaired people or rather 5% of the world's population, bringing such people substantially closer to full participation in the economy.⁸⁴ It could also open the door to numerous other innovations that leverage AI to solve a range of seemingly unsolvable medical challenges.

With the advent of 5G telecommunications, cloud computing, and AI, the opportunity to bring a greater social equity in terms of access to technology (at affordable cost) has never been better. High speed broadband access to flexible and distributed cloud platforms can bridge the digital divide, and bring AI-enabled products and services to the previously underserved, essentially bringing a new population into the economy, elevating local economies, and improving the quality of life.

Correspondingly, bridging the digital divide makes it easier for companies to bring to market new services that may be designed to help the underserved (e.g., rural farming), or others which may expand global reach for a company based in a less commercial location (e.g., crafts makers). Finally, doing so gives individual entrepreneurs and companies of all sizes, regardless of location, access to cutting-edge data tools, limitless storage, sophisticated software, and

the ability to scale up or down quickly according to individual needs – all without requiring investment in expensive servers or computers.

4. Improving Regulatory Coherence and International Cooperation

Globalization and digitalization have led to greater connectivity, which in turn has rapidly increased the quantities of data flowing between devices, platforms, and networks. The ability to move data across borders, and leverage data from multiple jurisdictions to improve AI, or to use the same AI product or service across multiple economies gaining the commercial benefits of scale, are major issues for developers, as well as impacting the commerciality of many business opportunities. Government efforts to minimize compliance costs by aligning legal requirements across jurisdictions is essential to ensuring AI innovations are shared and enjoyed broadly.

For example, **VolparaDensity**, the developer of the breast cancer clinical tool discussed in Section 1, possesses the world's largest database of anonymized breast cancer imaging data. Gathered across 39 markets, the database can be used to better understand the way different types of cancer affect different cultures and peoples – advancing the understanding of cancers. However, health privacy regulations may not allow such data to be used for purposes other than that for which it was originally collected (i.e., breast cancer diagnosis). The cost of complying with differing privacy laws may be prohibitive. Ensuring such complex compliance when making the data available to research institutions across the globe may be unmanageable. To look at it another way, the public clearly benefits from these cross-border data flows. There is increasing reliance on access to large data sets to improve research in a range of areas, including broader economic, climate, food supply, and migration issues, as well as more narrow foci such as healthcare, energy consumption, and logistics. Notably, cross-border data sharing has proven critical in saving lives and understanding the COVID-19 pandemic.⁸⁵

Compliance with differing cross-border data rules can be a greater challenge for smaller enterprises. From banking to trade to e-commerce, cross-border data flows have long been an enabler of international growth for a business. Many new, AI-driven business models serve a wide range of economies, and thus rely on efficient cross-border data transfers to scale. SMEs, especially, benefit from the availability of cloud services and cross-border data flow to reduce costs and expand markets. Small businesses, like large ones, can reach global markets and leverage data-driven services to meet consumers' fast-evolving needs and expectations, but only if compliance complexity and cost is not a barrier.

With the objective of greater coherence, APEC member economies should pursue cooperation in developing regulatory compliance requirements impacting upon AI. In June 2020, Singapore, Chile, and New Zealand signed the Digital Economy Partnership Agreement (DEPA). The agreement contains a section devoted to enabling ethical AI governance frameworks that take into consideration internationally recognized principles, including explainability, transparency, fairness, and human-centered values. One of the objectives of the agreement is to have various systems in the three countries operate seamlessly with one another to improve trade flows.⁸⁶ The DEPA reflects a coherent approach to policy and regulation across APEC member economies to make it easier and more affordable for AI businesses of all sizes to operate efficiently and profitably across APEC markets. This type of approach will also lead to wider adoption of industry best practices, which itself leads to better compliance in a dynamic digital economy.

5. Preparing Jobs and Skills for the Transformations of AI

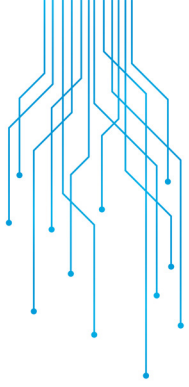
Although there is concern that technologies such as AI-driven robotics will replace some workers,⁸⁷ there is already the recognition of an ever-growing need for properly trained workers. As AI strategies continue to develop, an important consideration therefore is how best to address the skills needed for these emerging requirements and opportunities, and how existing jobs will change with the use of AI.

In New Zealand, **Ripper Group** has developed AI-powered crocodile-spotting drones to keep swimmers safe in Australian rivers. Equipped with cameras, sirens, speakers, and floatation devices, the drones can deliver urgent help to swimmers once deployed remotely by lifeguards.⁸⁸ Such solutions help save lives in a more efficient and safe manner. Critically, the deployment of the drones depends on lifeguards acquiring the skills to operate these specialized machines. Similarly, Australian gold producer **Newcrest Mining** is deploying autonomous drones, unmanned vehicles, and machine-learning algorithms across its mining operations in Papua New Guinea and Indonesia.⁸⁹ These solutions will undoubtedly improve efficiencies in mining projects and improve the economics of mining operations. Again, as with the Ripper Group solution, deployment of the new technologies requires upskilling local exploration and extraction technicians.

In many businesses, the changes may require skills beyond those for operating drones and other unmanned devices. Businesses developing or deploying AI-based innovations may need a workforce with more advanced knowledge. In fact, the development and implementation of AI may demand skills and abilities other than computer science expertise, including previously less demanded industry skills such as complex problem solving, creativity, cognitive flexibility, emotional intelligence, and critical thinking.

Equipping students and workers with these abilities, along with STEM skills (science, technology, engineering, and math) is key to solving two interconnected policy issues related to AI: the risk of widespread job losses due to displacement, and the rising talent gap that businesses face as they increasingly incorporate AI-based technology. Given uncertainties as to the types of work that will be available as jobs and the workplace are transformed, formal, vocational, and lifelong education and workforce retraining will have to prepare students and workers to meet skills challenges on an ongoing basis in an evolving job market.⁹⁰

In addition to education reform and skilling, labor market policies that enable greater worker mobility and flexibility – for example, through relaxed licensing requirements for certain occupations and more portable workplace benefits – can help APEC member economies meet this challenge. With the right opportunities, workers in APEC member economies will be able to prepare for the anticipated changes within a company, and more broadly, in the job market across the economy. With the current post-COVID-19 economic downturn, the ensuing growth in unemployment and need for investment in economic recovery, there is an opportunity to address both recovery and the preparation of the workforce to meet industry's evolving needs. As APEC member economies and economic recovery aid programs evaluate how to best invest, they should seize the opportunity to address this longer-term objective.



Recommendations

1. **Include AI as a part of the broader APEC economic agenda**

Presently, AI is contemplated within APEC as a technology issue. Rather, it should be viewed through the lens of economic opportunity and seen as central to forward-looking economic policy. Businesses adopt AI to pursue efficiencies, new business opportunities, and ultimately growth and competitiveness. For entire industries, AI will transform business processes and result in new products and services. The opportunity that AI presents to transform the economics of key industries in APEC member economies is a transformation that will ultimately drive growth for entire economies and for years to come.

- As APEC member economies look at their potential growth, and APEC leaders collaborate to pursue economic growth for the region, ABAC urges APEC leaders to: recognize the many ways AI is already having on-the-ground impact on business practices, processes, models, and opportunities; use this information to make evidence-based, policy decisions on AI; and position AI as a key component of overarching economic agendas, as well as of sector-specific digital transformation plans.

2. **Build trust in AI**

Concerns about AI not being used ethically can undermine public confidence in AI and impair business opportunities. Businesses are beginning to address these concerns by building fairness, responsibility, and ethics into the AI systems they develop and adopt. APEC governments can support these efforts by developing principles-based policy frameworks for ethical, socially responsible AI innovation and use that aligns positive business use and opportunity with the public interest. Further, applicable government regulations were often enacted long before technologies such as AI were contemplated. Regulators should make targeted revisions to current laws, including data protection frameworks, to properly address the specific needs of AI innovation.

- As APEC member economies design, implement, or adjust AI strategies and frameworks, and APEC leaders launch multilateral discussions and agreements on AI, ABAC urges APEC leaders to: encourage regulators, industry, and other stakeholders to make fairness, transparency, accountability, explainability, and ethics part of the design and implementation process of AI products and services; support and drive the emergence of sector-specific, industry-led efforts to develop ethical principles, guidelines, and frameworks for AI; and launch targeted revisions or adjustments to outdated or inadequate regulations that may hinder the public's understanding of and confidence in AI.

3. Introduce supportive policy frameworks for AI

AI, like other digital technologies that have transformed entire sectors, is most impactful on economic growth when supported by sound, coherent public policy that encourages innovation and creates market opportunities. With the need to reboot economies post-COVID-19, each APEC economy should take this opportunity to coordinate the work of government to create the policy environment that will support entrepreneurs, technology firms, and research institutes operating across APEC to advance AI innovation and adoption.

- As businesses in APEC economies turn to AI to maximize relevance, profitability, and competitiveness, ABAC urges APEC leaders to:
drive AI adoption by using AI to improve government business processes and the delivery of citizen services; developing government AI investment and procurement schemes to support the emergence of an ecosystem of AI entrepreneurs, SMEs, and researchers; work closely with AI specialists in industry and academia to develop AI policies and regulations that encourage innovation while protecting the public interest; and lean on the expertise and knowledge of the broad spectrum of AI stakeholders to ensure policies and regulation effectively reflect on-the-ground needs and expectations.

4. Improve regulatory coherence and international cooperation

Regulations and frameworks that have common core principles help businesses reduce compliance costs, especially as they extend their business models across jurisdictions.

- As APEC economies develop AI frameworks and strategies, ABAC urges APEC to:
strengthen AI-specific cross-regional cooperation initiatives to achieve greater regulatory coherence and consistency across the APEC region; and, encourage regulators, industry, and other stakeholders to collaborate to develop a coherent regional approach to regulation and compliance for AI.

5. Prepare jobs and skills for the transformations of AI

Economies will see the greatest positive impact of AI on the workforce with sufficient reform in education and the availability of workforce training and reskilling, particularly related to computer science and STEM subjects, but also the so-called 'soft skills', which allow workers to trade on their uniquely human capabilities: complex problem solving, cognitive flexibility, emotional intelligence, creativity, and critical thinking. Workers need to possess these additional personal skills to be able to both use and benefit from AI applications in the workplace.

- As APEC economies turn to AI and other data-driven technologies to plan and operationalize their post-COVID-19 economic recovery, ABAC urges APEC to:
equip students and workers with the skills to navigate a rapidly evolving and increasingly uncertain job market; strengthen workforce training and reskilling programs; help businesses address the rising AI talent gap by making retraining a key pillar of education policies; and collaborate at the regional level to ensure AI knowledge, skills, competencies, and certifications are transferable across APEC economies.

6. **Create opportunity from the COVID-19 economic recovery**

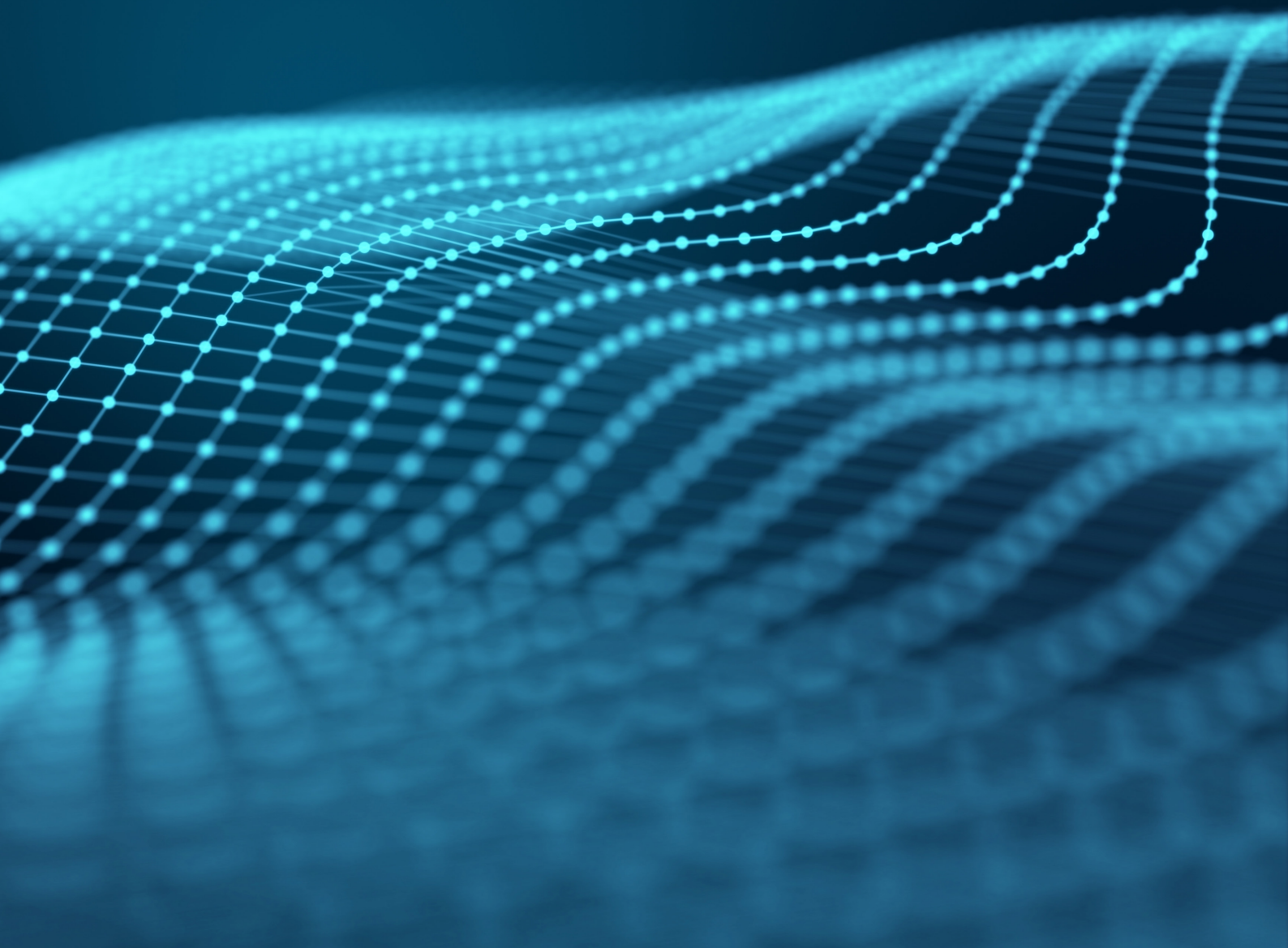
The COVID-19 crisis gives APEC governments and businesses the chance to 're-boot' the economy in a way that addresses short-term market needs (i.e., support businesses as they leverage AI to improve productivity, profitability, and competitiveness) and supports long-term economic objectives (i.e., provide equal and inclusive access to the economic opportunities created by technological innovation).

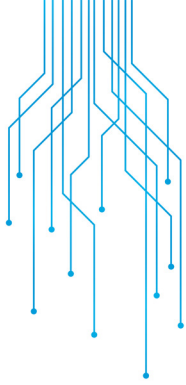
- ABAC urges APEC to:
encourage governments and international aid programs to evaluate how to best invest in post-COVID-19 economic recovery; further drive plans and initiatives targeting the improvement of basic and crucial connectivity to underserved communities; ensure the dividends of technology-driven growth and prosperity benefits businesses as well as communities.

ANNEX 1

Case Studies from APEC Member Economies

This annex presents a selection of notable case studies that were cited and/or used as evidence of AI adoption and deployment across APEC economies throughout the report.





Australia

Mastercard leverages AI to fight credit card fraud

The on-going COVID-19 pandemic is demonstrating the importance of non-cash payment systems in driving and sustaining economic activities.

It has, in the first instance, demonstrated the impracticality of using cash in a data-driven world in which physical presence or contact⁹¹ are no longer crucial to successful business transactions – a reality that will accelerate emerging and mature economies' transition to a completely cashless system.⁹²

Most importantly, the confinement and distancing measures that have been implemented to curb the spread of the virus have intensified the use of digital platforms (delivery applications, e-commerce platforms) – highlighting the digital economy's reliance on secure digital transactions.⁹³

In this context, the sheer volume of global digital transactions conducted over cross-border virtual platforms is creating new security challenges for the payments industry.

Chief among them is the risk of fraud. Credit, prepaid, and debit cards have indeed emerged as the most commonly used cashless payment method.⁹⁴ At the same time, the number and type of third-party vendors and partners handling card users' information is rising rapidly. Together, these two trends increase the chances of sensitive information being compromised.

Mastercard, for example, experiences 200 fraud attempts per minute, and between 2018 and 2020 the value of fraudulent authorization attempts has declined by USD14 billion. The stakes in these fraud cases can also be enormous, with individual incidents potentially costing millions in lost funds across multiple unprotected accounts.

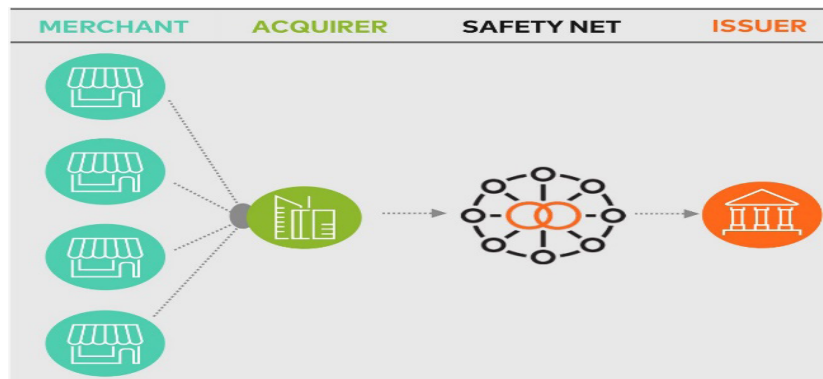
It is not surprising, then, that Mastercard is leveraging advanced technological tools such as AI to fight against fraud and avoid millions in potential fraud losses.

Training algorithms to detect fraud

Since 2018, Mastercard's AI-powered Safety Net guards against large-scale fraud events, detecting and intercepting suspicious activities across the Mastercard network in real time. Safety Net monitors global authorization data for abnormal activity, taking account of spending patterns across channels, cards, and Bank Identification Numbers (BINs).

Mastercard's AI team trains the Safety Net Algorithm by exposing it to transaction and authorization data, teaching it to autonomously identify potentially fraudulent transactions. Supervised learning techniques allow Safety Net to develop predictive models that determine if observed patterns and activities (authorization data, tracking location, velocity indicators, and profiling across transaction channels) are abnormal.

Safety Net's relationship with merchants, acquirers, and issuers



Source: Mastercard⁹⁵

Making credit card transactions safer

If Safety Net determines that a transaction may be fraudulent, it can automatically decline the transaction, directing customers to self-serve tools to review transactions declined by Safety Net and to white list cards if card activity is genuine.

Should threats escalate to involve tranches or groups of potentially fraudulent transactions, Safety Net can temporarily block transactions across an entire channel. In cases of even further escalation across multiple cards or BINs, Safety Net automatically refers the issue to a Mastercard Tactical Response Team for emergency investigation.

Mastercard's Safety Net has been put to the test in various situations and has helped issuers avoid losses in different markets. In one instance, it detected a massive merchant spoofing attack, and blocked USD26 million in fraud losses for issuers around the world.

Safety Net can detect ATM cash-out attacks, blocking some USD500,000 in potential fraud losses for issuers in Europe alone. It is also able to account for attacks depending on weaknesses in validation systems, such as exploits that target a gap in chip validation protocols.

Safety Net's detection algorithm is even able to account for human error; upon detecting an issuer's accidental deactivation of a chip cryptogram validation protocol, it blocked over USD11,000 in potential fraud losses.

According to Ed McLaughlin, Mastercard's President of Operations and Technology, "Thanks to advances in artificial intelligence and machine learning, our technology can detect and address fraud more accurately and more quickly than before."⁹⁶

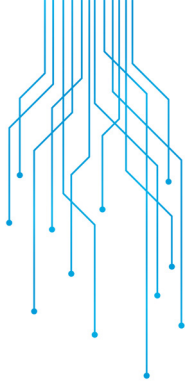
Enabling transactions for a secure digital economy

Safety Net demonstrates the benefits of a holistic and dedicated approach to AI – especially when it is used not only as a productivity tool but to enhance an organization's core competencies.

Indeed, Safety Net not only safeguards the information users share with each of their transactions, it helps them trust that the information they share is safe, no matter which unprecedented crisis is disrupting the processes and activities that keep entire economies afloat. It also shows that the human element – what ICT experts see as any system's main vulnerability – can be removed from at least part of the equation without losing in reliability.

As Ed McLaughlin notes, "What is most important is to take the human out of the loop, so that they do not have access to personal data at the point-of-sale. It is about how powerful tools are used around AI to increase cybersecurity and protect consumers."⁹⁷

In this sense, Safety Net lays the groundwork for safer cross-border and cross-platform transactions and embodies the potential of AI as a means of empowering consumers to address the challenges of an increasingly hyper-connected world.



Chile

Genomawork uses AI to predict job seekers' potential

From small businesses⁹⁸ to multilateral organizations,⁹⁹ achieving holistic, sustainable, and inclusive digital transformation is at the top of economic strategies. One sector that is both undergoing and driving change is human resources (HR). According to Brian Kropp, Group Vice President at Gartner, "Digitalization is changing everything; from core functions like the way we hire and develop talent to new burdens such as raising performance."¹⁰⁰

In this context, the stability and prosperity of organizations hinge on HR's ability to find the right person. This entails not only recruiting someone with the right skills for the right job, but doing so at the right time and for the right cost. And these different moving parts will only grow more constraining as recruitment practices and professional opportunities are affected by the economic challenges created by the COVID-19 crisis.¹⁰¹

Chilean HR start-up Genomawork is looking to help organizations avoid such struggles by leveraging AI to make recruitment processes more efficient, predictable, and successful.

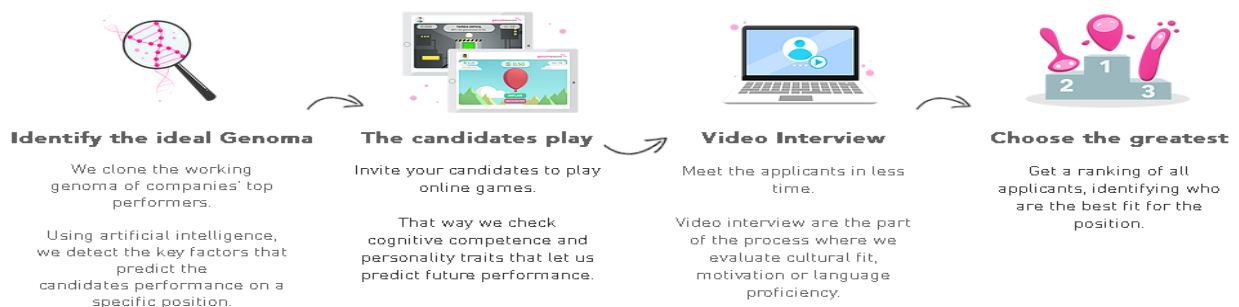
Finding the right fit with AI

Genomawork uses Genoma, an AI algorithm that detects candidates' personality traits and cognitive skills and assesses them against a set of pre-defined reference performance indicators.

A company only has to define the ideal traits or skills it is looking for in a given position, and Genoma identifies which potential candidate is the right cognitive and/or emotional fit. It does so by processing thousands of inter-linked variables collected when candidates play a series of online games developed specifically to assess their choices, actions, and reactions.

These neuroscience-based games allow the AI to pick up on a multitude of personality traits, providing unprecedented insights on candidates' behavior and personality. It also predicts how the candidate may execute his or her duties once on the job, as it can compare his or her traits with those of an ideal candidate defined as a reference model.

An objective and precise automated recruitment process



Source: Genomawork

Nothing left to chance

Genomawork complements this automated process with more traditional face-to-face video interviews that further indicate candidates' viability in terms of language proficiency, cultural fit, and system of values – many elements that cannot yet be captured via the gaming exercises.

Once the process is completed, Genomawork gives companies a ranked assessment of applicants, including information on people that may lack relevant experience but possess hidden potential for a given position.

This benefits companies by allowing them to make the final call with all the necessary elements in hand, including factors they might not have suspected they needed to look for. This not only cuts down the time and effort spent sifting through resumes, it ensures that all bases have been covered before a decision is made.

"Genomawork has had an 85% accuracy rate in matching candidates with a company's recruiting needs," says Daniel La Roche, Co-Founder of Genomawork. "Responses have been very positive in qualitative terms, and we expect them to remain that way as our clients begin measuring the performance of employees who were hired through Genomawork."¹⁰²

For candidates, the benefits are much more introspective; they can access their assessment and find a trove of information they may not have known about themselves – the way they think, the way they approach problems, how they perform under pressure, etc.

"On a scale of one to ten, job applicants give Genomawork an average score of 9.2," says La Roche. "This shows that their overall experience with the platform is positive, even when they were not selected for the job they applied for."¹⁰³

Assessment of candidates' trait and skills against a base reference model



Source: Genomawork

Removing biases from the recruitment process

For La Roche, using AI for the purpose of recruiting is much more than simply deconstructing candidates' personalities and experiences into algorithmic variables. And, even though it may be a key objective for many of the company's corporate clients, it is not only about increasing accuracy and efficiency.

Indeed, the Genoma system also aims to make recruitment fairer and less biased – a particularly important endeavor in a world where most organizations still rely on inconsistent and indiscernible methods to recruit the people they want to invest in.

Despite its many limitations – over-reliance on cliché words and expressions, unverifiable or exaggerated information, physical limitations and constraints of the paper format, to name but a few – the curriculum vitae (CV) remains the main vector of assessment of an applicant's potential fit.

Over the years, the process of submitting a CV has been made slightly less arbitrary by making

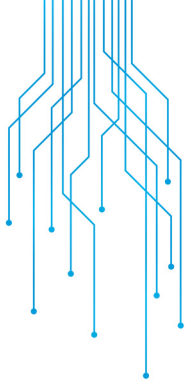
it unnecessary to include identifiable information that may be used against an applicant (photo, name, gender, address, date of birth, marital status), but it remains an unreliable predictor of professional ability and performance.

“CV-based recruitment is an inaccurate and costly process for companies,” says La Roche. “The CV is a bad predictor of performance and there is a high probability of making a judgement error and re-starting the recruitment from scratch after a few months. The direct cost of this error can be significant, as well as the cost of missing a potentially promising candidate just because there were too many CVs to read.”¹⁰⁴

In addition, there are many biases at play, biases that even the people in charge of selecting and interviewing candidates may not be aware of.

“From the moment a CV falls into your hands, a thousand micro-judgement calls are made, most of which are heavily biased,” says La Roche. “A person’s name, the university they attended, the extent of their social and professional networks – all of these elements can work for or against a person, regardless of their relevance to the job and regardless of their impact in the person’s skills or ability to perform.”

In this sense, Genoma is not just an algorithm that automates functions and saves time and money. It is also a disintermediation tool that removes the limitations created by a subjective and biased assessment of people’s true potential.



People's Republic of China

Huawei uses AI to improve and accelerate COVID-19 diagnostics

The COVID-19 pandemic has had a disruptive effect on the world. Since its emergence in late 2019, the virus has brought the global economy to a standstill.

More importantly, the virus has claimed the lives of hundreds of thousands around the world, with the number of infected rising into the millions. In the People's Republic of China alone, the virus has infected over 80,000 people and killed more than 4,500.¹⁰⁵

Healthcare systems in mature and emerging markets are buckling under the pressure of this global crisis. Though many of those who have been infected have received treatment, healthcare professionals, tools, and resources are unprecedentedly strained. And many more infected people may potentially be going undetected and untreated.

Early detection is key to mitigating the pandemic

In this context, early and accurate detection is an absolute priority for governments around the world.

Antibody tests are becoming more widely available, but for now their speed and convenience is trumped by their low accuracy.¹⁰⁶ Meanwhile, polymerase chain reaction (PCR) tests conducted in laboratories are labor intensive, with several stages at which errors (and false negatives) may occur.¹⁰⁷

As we learn more about the virus and the way it impacts the human body, more can be done to ensure that fewer people fall through the cracks.

AI-assisted imaging for better diagnoses

Huawei CLOUD's Medical Imaging AI is collaborating with its partners Lanwon Technology and HY Medical to address this issue.

It leverages the EIHealth platform – a professional R&D platform designed to accelerate research in new applications for AI in genomics, drug discovery, and medical imaging – to develop and deploy an AI program specifically designed to diagnose COVID-19 in CT scans of patients' lungs.

CT scans are fast and accurate but need to be rechecked and reviewed multiple times over short periods of time because of the large number of lesions caused by COVID-19, and the often-rapid changes the virus creates within the lungs. This can significantly increase the workloads of imaging specialists who are often short in supply at most hospitals.

The AI-assisted Patient Screening system for COVID-19 relies first on the guidance of doctors

who label the tell-tale lesions caused by COVID-19-induced pneumonia in CT scans of patients' lungs. Labelled CT scans are then used by AI scientists at Huawei CLOUD to train an algorithm to independently identify similar symptoms in other CT scans.

The algorithm uses computer vision and medical imaging analysis to quickly and accurately output CT quantification results. Having analyzed hundreds of infected and non-infected patients, the algorithm uses Dice Similarity Coefficient (DICE) statistical analyzes and Absolute Volume Difference (AVD) imaging technology.

User Interface for the Huawei CLOUD AI-Assisted Screening system

UIs of the HUAWEI CLOUD NCP-CT AI-Assisted Quantitative Diagnosis Service



The left image shows a two-dimensional pneumonia area segmentation system, and the right image shows a three-dimensional quantitative pneumonia volume follow-up system.

Source: Huawei

DICE and AVD are used in concert to automatically segment lesion areas: DICE overlaps predicted and actual lesions, while AVD identifies the differences in volume between them. The results are consistent with doctors' manual sketching.

The screening system is then able to automatically identify and digitally segment lung lesions and measure lesion volume. This allows the rapid diagnosis of symptomatic patients carrying the COVID-19 virus – up to three days faster than other testing methodologies.

Supporting and complementing doctors' work

According to Huawei CLOUD Healthcare Manager Mr Zhang Shaowei, "The components of the EIHealth platform use different AI techniques, including Machine Learning, Deep Learning, and Knowledge Graph Learning to power a screening system which can autonomously and holistically integrate the lessons learned by our medical professionals."

This process also boasts an impressively high accuracy rate, correctly identifying carriers 98% of the time. Using this technique, doctors can delegate the task of reading CT scans to the AI and focus instead on the important work of treating patients.

Furthermore, for confirmed cases in hospitals, the AI-Assisted Patient Screening system can quickly perform registration and quantitative analysis on the data acquired over multiple rechecks of the CT scans, thereby helping doctors evaluate patients' conditions and the impact of targeted drug treatments.

As Mr Zhang notes, "The system does not fully replace the work that doctors do, but enhances their capabilities by adding an additional line of defense in the diagnostic process."

Doctors at Sungai Buloh Hospital being briefed about the AI-Assisted Screening system



Source: Huawei

Exporting the expertise

Huawei CLOUD has already deployed the AI-Assisted Patient Screening system in 60 hospitals across the globe, including Malaysia, Thailand, Italy, and Ecuador.

In Malaysia, Huawei is working with the Ministry of Health to deploy the system in the Sungai Buloh Hospital (state of Selangor). Dr Yun Sii Ing, Head of Department for Clinical Radiology at the hospital, recently stated that, "[...] This equipment (...) will help save lives by greatly reducing the risk of infection and enabling medical personnel to perform their duties better and faster."¹⁰⁸

In Ecuador, the General Hospital of South Quito was connected to Huawei's AI system, enabling diagnoses just 14 hours after its launch. Otto Sonnenholzner, Vice President of Ecuador, took to social media to thank Huawei for making Ecuador the first Latin America territory with AI-powered diagnostics.¹⁰⁹

Beyond the COVID-19 pandemic

Huawei CLOUD's algorithm holds promises beyond the current crisis.

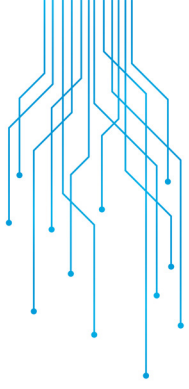
Designed to adapt quickly to the type of data it receives, the AI program can be fed new information on changing or evolving symptoms, allowing the system to tailor its delivery of diagnoses accordingly. This quality is vital, as new information about the virus is continuously coming from on-the-ground reports, and any delay in processing this information can cost human lives.

The system will also contribute to more long-term research on the virus. The data that is generated by the AI-Assisted Patient Screening system is usable in quantitative analysis and can be used to generate 3D reconstructions for further assessment. Data can also be easily exported and utilized for further quantitative tasks, as well as shared between medical teams.

The speed at which Huawei CLOUD's existing platform was configured to address a new and emerging problem is also a testament to the progress AI scientists have made in introducing flexibility into the design process of AI platforms.

Mr Zhang sees this flexibility as a key driver of AI's ability to address broader humanitarian challenges in the near future.

"AI scientists are getting better at adapting algorithms and using AI to solve new and more difficult problems," he says. "The work of Huawei and other AI companies during this pandemic is proving that AI-powered solutions will play an increasingly larger role in a wide range of disaster-management strategies in the future."



Japan

NEC optimizes agricultural processes with AI-powered platform

All around the world, agricultural businesses face similar challenges. Not only must they meet a rapidly growing demand for agricultural products, they are expected to do so while overcoming a number of complex, intertwined obstacles – climate change, soil degradation, pests and diseases, expensive machinery, limited access to financial support, reduced workforce, to name but a few.

The sector's reliance on large quantities of water and fertilizer also creates sustainability challenges. According to the Food and Agriculture Organization (FAO), "Satisfying increased demands on agriculture with existing farming practices is likely to lead to more intense competition for natural resources, increased greenhouse gas emissions, and further deforestation and land degradation."¹¹⁰

In short, existing farming operations can no longer meet demand in a sustainable manner, and it is urgent to find a more adequate and responsible approach.

Using technology to overcome challenges

A number of technological solutions have been developed to overcome productivity and sustainability challenges. Agricultural biotechnologies, for example, have yielded results for decades. From low-tech approaches (artificial insemination, fermentation techniques, biofertilizers) to more high-tech methods (advanced DNA-based methods, genetically modified organisms), a range of solutions are at the disposal of agricultural businesses.

In this context, AI is emerging as a viable and reliable way of improving agricultural processes and mitigating their impact on the environment. Through automated data collection and data-based decision-making, AI-augmented agriculture allows corrective measures to be made automatically and in real-time.

Whether it is the detection of crop diseases or the nutrition levels of livestock, AI can help increase resource efficiencies at all levels of the value chain – from lowering the use of water, fertilizers, and pesticides to increasing yields and outputs.

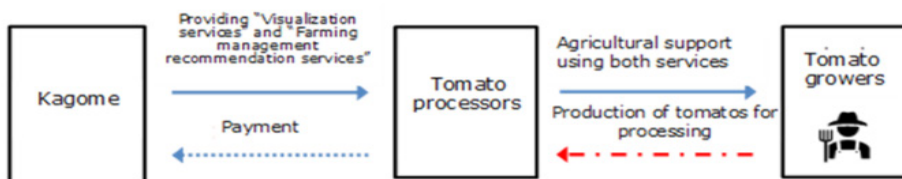
Leveraging AI to improve tomato-growing processes

In Japan, IT and network solutions company NEC has partnered with food manufacturer KAGOME to launch CropScope, an AI-powered system that uses sensor data and satellite images to help farmers visualize tomato growth, monitor soil conditions, and receive specific farming recommendations.

While CropScope can be applied to a range of agricultural products, tomato-growing was selected because demand for tomatoes in their raw form as well as in various processed forms is

significant, and because it is a difficult crop to grow with yield varying widely among producers.

Process and key stakeholders involved

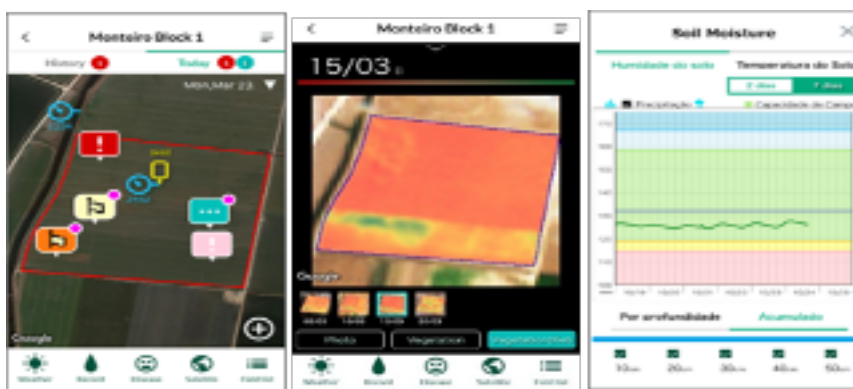


Source: NEC-KAGOME

Five years in the making through a transnational proof-of-concept (POC) across Australia, Portugal, and the United States, the joint project helps tomato growers leverage the vast amounts of data they may not even be aware are at their disposal.

The AI-based farming recommendation service automatically aggregates and analyzes a wide range of data points – weather, soil, water quality – and keeps tomato growers informed on a number of micro-decisions they must make to ensure their crops are healthy, their yield is stable, and their cultivation costs are lowered. To account for challenges in accessing vast amounts of agricultural data, the AI’s learning process was modelled in such a way that it could be effective even with a relatively small amount of data.

Big data enables large farms to quickly grasp crop conditions, detect irregularities, and make swift agricultural decisions



Source: NEC-KAGOME

This allows even the smallest of tomato-growing operations to access the type of specialized expertise that bigger or more experienced businesses possess. A 2019 experiment in Portugal saw KAGOME’s farmers requiring 20% less fertilizer to yield 30% more tomatoes than the domestic average.

Accessing knowledge for greater opportunities

In addition to enabling a range of cost-saving efficiencies, CropScope also makes environmentally sustainable agriculture more accessible for small, young, or local farming organizations.

By reducing the need for farmers to rely on experience and intuition, the barriers to agriculture are significantly lowered. Enabled by AI, this democratization of sustainable agriculture makes it less daunting – and far more economically viable – for younger populations to take up jobs in tomato farming.

In the long term, these shifts can help mitigate the impact of rampant urbanization and rapid population ageing in the agriculture sector. Japan, as many other economies, is facing severe labor shortages in agriculture, with 60% of farmers above the age of 65.¹¹¹ In addition, significant cost savings and productivity gains help level the playing field for small farms and co-operatives, allowing them to compete more effectively with large farming corporations.

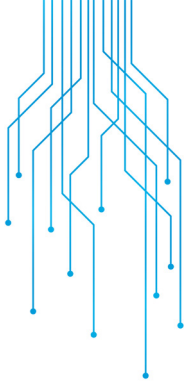
Moreover, these benefits are not limited to tomato farmers and can be enjoyed down the tomato production supply chain. For example, tomato processors also enjoy lower procurement costs and predictability of yields, helping them minimize risks and streamline their production processes.

Beyond productivity, the promise of food security

Around the world, the COVID-19 pandemic has highlighted major gaps in everything from healthcare systems' resilience to protection mechanisms for the most vulnerable members of society. Chief among populations' preoccupations was the governments' ability to maintain a stable and continuous provision of food products through the crisis.

In Singapore, where imports account for a significant part of food products, panic-buying and hoarding were seen early in the pandemic.¹¹² And economies with strong agricultural sectors were not spared, as similar scenes were observed in France, Japan, and the Netherlands.¹¹³

Reduced input costs and entry barriers resulting from the adoption of AI can help increase the stability and continuity of agricultural outputs in the global marketplace. This is important for the long-term sustainability of economies' agricultural sectors, as well as for their overall future food security.



Mexico

Yalochat uses AI to provide immersive, personalized customer interactions

In a globalized, inter-connected digital economy, capturing potential customers' attention and keeping existing customers engaged is at the top of business leaders' agendas.

This is especially true in emerging markets that are at once incredibly populous, rapidly urbanizing, and increasingly digitalized – markets in which the sheer volume of an informed, connected, and sophisticated middle class pushes businesses to the edge of efficiency and competitiveness. From the People's Republic of China, India, and Indonesia¹¹⁴ to Brazil, Colombia, and Mexico,¹¹⁵ consumers want products that surpass their expectations and services that anticipate their needs.¹¹⁶

In this context, it is no surprise that businesses are moving away from traditional support tools like phone calls, emails, and tickets – considered slow and impersonal modes of communication – towards chatbots and Live Chat features, which deliver immediate and personalized customer experiences at no extra cost.

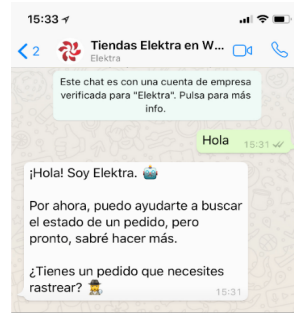
In Mexico, the AI platform Yalochat is transforming the way customers interact and transact with businesses.

Making a difference with conversational AI

Based in San Francisco, Yalochat aims to turn chatbots into more than a digital platform passively or reactively providing basic information. Its aim is for customers to be able to speak to chatbots as naturally and as intuitively as they speak with another person. Only this other person has all the answers to any possible query, does not doubt or hesitate, is able to anticipate someone's next string of questions based on speech content and patterns, and even makes on-point recommendations – suggesting the right product at the right time.

For added comfort and convenience, Yalochat wants all of this to take place beyond the confines of a business' own website (which may or may not be optimized for mobiles) and into the messaging platforms in which consumers are already having meaningful discussions (WhatsApp, Facebook Messenger, LINE, WeChat, to name but a few).

Conversational AI for personalized customer experiences



Source: Yalochat

Transforming customers' experiences and perceptions

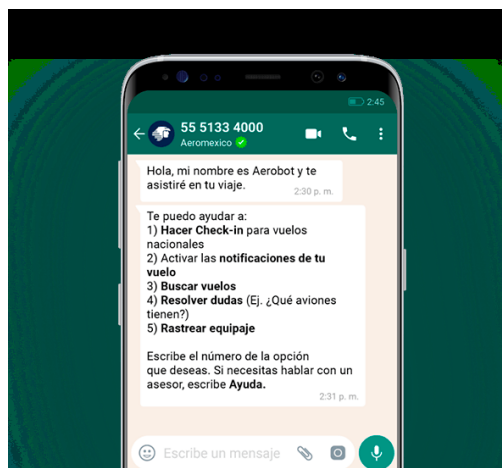
One of Yalochat's key clients, the Mexican retail giant Coppel, has significantly improved the way consumers perceive its brand thanks to more useful and genuine WhatsApp interactions. Apart from finding the nearest Coppel branch and its opening hours, Yalochat allows customers to check on their consumer credit applications, receive purchase confirmations and notifications, and quickly resolve Frequently Asked Questions (FAQs) – all within WhatsApp.

Aeromexico, Mexico's domestic airline, has migrated part of its customer service platform to WhatsApp and Facebook Messenger via Yalochat.

According to Javier Mata, CEO of Yalochat, "This new service allows passengers to receive answers to any question in a faster way, since it gives them access to the personal attention of the customer service team, in addition to providing automated responses in real-time."

Aeromexico's customer service is now available 24 hours a day, seven days a week on WhatsApp, allowing customers to receive their digital boarding pass and ask all sorts of questions from within WhatsApp – i.e. "What time do I need to check-in?", "How many pieces of luggage can I take on my flight?", or "What is the process to take my pet with me?". The service is also fully customizable, as users can tell Aeromexico that they only want important flight-related notifications and no support whatsoever.

All roads lead to WhatsApp for Aeromexico



Source: Aeromexico

Reaching the unreachable

Other than the obvious commercial benefits, making customer service less of a chore and more of an experience has many other benefits.

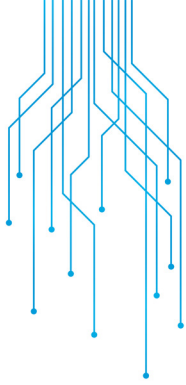
A major advantage of leveraging existing messaging platforms is the ability to reach entire segments of the population who do not yet have the habit of seeking information through digital sources. The elderly, for example, may use WhatsApp to keep in touch with friends and family, but may not be aware that practical information can also be delivered there. There are also the un- and under-connected, who may not have access to sufficiently strong or reliable internet access to spend too much time looking for hard-to-find information on a messy or unintuitive website.

And the benefits also work the other way around; many businesses still do not have a strategically planned or implemented digital footprint. And those that do have digital assets that they use for communications tend to ignore the fact that these need to be adapted to consumers' specific digital habits.

According to the 2018 survey on the availability and use of ICT in Mexican homes, 92.2% of the Mexican population uses a mobile device to access the internet, out of which 86.9% do so to access practical information and 79.6% do so on a daily basis.¹¹⁷

As Javier Mata puts it: "Through our technology and in collaboration with WhatsApp, we can make it easy for companies to have happy customers who actually enjoy reaching out to customer service."¹¹⁸

In this sense, advanced conversational AI such as the one deployed by Yalochat may do more than just humanizing companies and brands; it may help make the internet a more inclusive and accessible resource by opening it up to many more people than ever before, while also adapting to their individual preferences



New Zealand

Volpara Solutions uses AI to improve breast cancer assessments

Artificial intelligence (AI) is having a major impact on New Zealand. It is transforming the economy by improving efficiency and productivity across organizations, and it is helping shape an intelligent society in which technology contributes to curb inequalities.¹¹⁹

Healthcare is one of several key sectors the government is prioritizing in its approach to AI, as the ageing population is increasing demand for medical services – straining resources, stressing infrastructure, and pushing costs upwards.¹²⁰

In this context, AI is poised to improve the way healthcare is managed and delivered in New Zealand. From data-driven diagnostics to automated administrative processes, AI can make healthcare faster, more precise, and less expensive.

Volpara Solutions, for example, is reducing the human and financial costs of breast cancer by providing clinically validated AI software that underpins effective, high-quality screening processes.

Timing and accuracy are key to reducing mortality

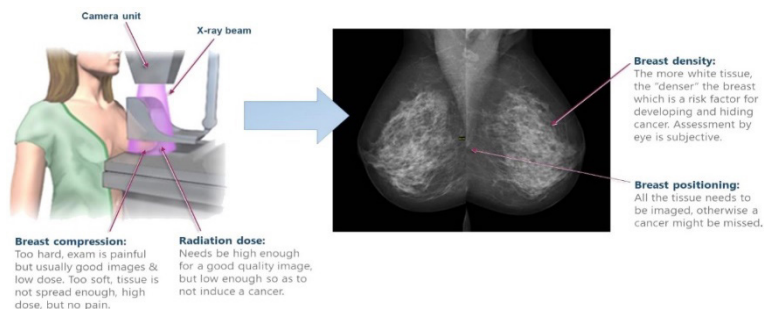
According to the World Health Organization (WHO), 627,000 women died from breast cancer globally in 2018 – or approximately 15% of all cancer deaths among women.¹²¹ Breast screening using X-rays (mammograms) is proven to reduce breast cancer mortality – by up to 41% according to some studies.¹²²

But two complex factors come into play in ensuring screenings effectively reduce mortality: timing (the earlier breast cancer is detected, the higher the chances of survival) and accuracy (the more precise an assessment is, the better an effective diagnosis can be prepared).

On timing, mammograms are more widely available than just a decade ago, though many women – especially in emerging economies – are still diagnosed at an advanced stage of disease.¹²³ On accuracy, mammograms are vital for finding breast cancer, but 1 in 5 cases can be missed.¹²⁴

A key challenge is breast tissue density. Breast tissue that is particularly ‘dense’ makes it difficult to see cancer, as both cancer and dense breast tissue appear white on X-rays.

Visualizing breast density



Source: Volpara Solutions

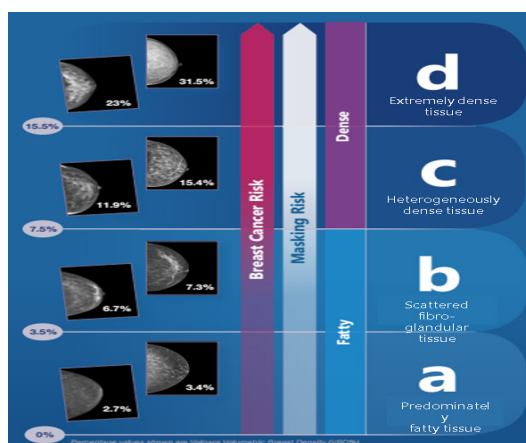
Assessing tissue density with AI-assisted computer vision

VolparaDensity applies a mix of computer vision and deep learning to analyze mammograms, automatically estimating breast composition and assessing breast density. Breast density is indeed indicative of risk of developing breast cancer – a risk that can be missed if an X-ray is only observed with the naked eye, regardless of how trained or experienced that eye may be.

According to Dr. Daniel Kopans, Professor of Radiology at Harvard Medical School, “Radiologists can guesstimate the percentage of breast tissue that is dense, but they are still using 2D information to assess a 3D phenomenon, and they cannot possibly be accurate in any absolute sense.”¹²⁵

Supported by Volpara Solutions’ suite of imaging software, VolparaDensity provides a repeatable, consistent, and objective means of scoring breast density – a ‘scorecard’ that accurately identifies which women may benefit from supplemental imaging, such as ultrasounds.

Automated breast density scorecard



Source: Volpara Solutions

According to Dr. Ralph Highnam, CEO and Founder of Volpara Solutions, “Our aim is to ensure that women get the right imaging according to their breast composition so that screening can detect any cancers as early as possible and thus reduce mortality risk and cost of treatment”.

Training AI to go beyond diagnostics

VolparaDensity is used in clinics in 39 markets, including Australia, Malaysia, New Zealand, Singapore, the Republic of Korea, Chinese Taipei, and the United States. The imaging data gathered by VolparaDensity is anonymized and stored in the cloud. From radiation doses to image quality, a wide range of X-ray data is available for AI researchers looking to improve breast cancer screening processes.

As Dr. Ralph Highnam notes: "With over 20 million breast images now stored, we have one of the world's biggest breast cancer datasets available to train AI systems in ways that were unimaginable just a few years ago. There is an opportunity to better understand the way different types of cancer affect different people, communities, and territories."

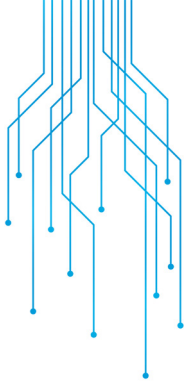
He adds: "The system could, of course, also be trained to enhance lung cancer screening. It would have to be calibrated and adjusted accordingly, but the core infrastructure is there – and it is highly adaptable."

Expanding human capabilities

VolparaDensity demonstrates how helpful AI can be if it is used as more than just a cost-cutting measure.

Dr. Ralph Highnam highlights that "AI systems such as VolparaDensity help medical professionals build on their existing abilities. It is not about replacing radiologists or their years of experience with a more affordable alternative. It is about drawing from their knowledge and skills to go even further; detect what is otherwise undetectable, trace what is otherwise untraceable."

"In this sense," he adds, "AI cannot be reduced to a simple productivity tool. To fully benefit from AI, we must see it as the catalyst for humans to expand their knowledge and augment their abilities."



Papua New Guinea

Total uses AI to collect topographic data in a safe, responsible manner

The United Nations (UN) estimates that the world population is expected to increase by 2 billion people in the next 30 years – from 7.7 billion today to 9.7 billion in 2050, and possibly peaking at nearly 11 billion around the year 2100.¹²⁶

From electricity to power devices and appliances to fuel to transport and shelter people, such population increases will necessarily lead to heightened demand for energy. If nothing is done to curb current trends, the International Energy Agency (IEA) sees energy demand rising by 1.3% each year to 2040, resulting in “a relentless upward march in energy-related emissions, as well as growing strains on almost all aspects of energy security.”¹²⁷

Indeed, despite a marked rise in the use of renewable energy resources, fossil fuels – namely coal, natural gas, and oil – remain a reasonably inexpensive resource and are expected to remain so for the foreseeable future. This results in hydrocarbon exploration expanding to new regions of the planet, increasing the breadth and scope of potential damage caused to ecosystems, wildlife, and indigenous communities.

In this context, it is essential that exploration operations be conducted as quickly and as efficiently as possible – reducing their short- and long-term environmental footprints.

Developments in the field of onshore seismic data acquisition have made surveying operations faster and more accurate, allowing for such exercises to be undertaken more efficiently and with less environmental impact.

Revolutionizing data gathering with AI

Seismic and topographical data are key to hydrocarbon exploration, but collecting such information is no easy task. In addition to minimizing the potential negative impact on surrounding fauna and flora, there are practical challenges that make gathering accurate, high-quality seismic and topographical data a slow and arduous process.

Existing methods of onshore seismic data acquisition call for a labor-intensive process involving large numbers of people moving in a coordinated fashion across terrain to strategically position sensors. And uneven or mountainous terrain, combined with poor weather conditions, can make this extremely dangerous for surveyors.

Total’s Multiphysics Exploration Technology Integrated System (METIS) is an autonomous AI system designed to address the logistical difficulties that make seismic data acquisition difficult. Conceptualized in 2015, the system aims to make data collection a quick and painless process. According to Pierre-Olivier Lys, Geophysics Operations & Technologies Manager at Total, METIS “improves the quality and speed of data acquisition through real-time quality control and

processing, while at the same time slashing both the cost and Health, Safety, and Environmental (HSE) risks of operations."¹²⁸

METIS relies on Downfall Air Receiver Technology (DART) recorders, which can be fixed into soft ground in upright positions in order to transmit data via high-speed real time radio telemetry systems to centrally located intermediate antenna towers. Data from these DART arrays will be collated and sent directly to base camps located a significant distance away.

While installing these DARTs would ordinarily require arduous labor, METIS employs fleets of autonomous drones which are able to conduct a multi-physics safety clearance check before releasing the DARTs over prearranged, optimal positions. This new data acquisition method is known as 'carpet recording'.¹²⁹

In each fleet, a remote-controlled leader drone is tasked with scanning the environment using Lidar and Infrared sensors in order to detect life forms and other potential obstructions. This is intended to enable the safe and environmentally responsible use of the carpet recording method.

DARTs and DART Deployment Drones



Source: GeoExPro

Should no obstructions be detected, the autonomous DART carrier drones will drop the DARTs from above the canopy, enabling them to impale themselves vertically in the soft ground below, and begin transmitting relevant seismic data. Drones can subsequently be tasked with filling in gaps in the array by dropping further DARTs, should surveyors later find that coverage is insufficient.

Successful testing in Papua New Guinea

The METIS system was trialed in Papua New Guinea, which contains promising hydrocarbon deposits that are often located in remote areas, and which are difficult to access and survey using traditional methods.

Reflecting on the challenges the terrain presented, Pierre-Olivier Lys describes Papua New Guinea's combination of uneven terrain and dense vegetation as "some of the most challenging terrain for seismic exploration in the world."¹³⁰

During METIS's pilot test in Papua New Guinea, approximately 60 DARTs were deployed in only

a few hours using a single autonomous drone, and they immediately began transmitting seismic data after being dropped – proving the utility of the concept. Fully equipped drone fleets will, in the near future, be able to safely deploy up to 400 sensors per square kilometer.

The METIS project's use of autonomous drones effectively replaces dangerous and environmentally damaging human labor, addressing two major challenges of hydrocarbon exploration at once. Real-time processing and rapid-subsurface image delivery will furthermore allow surveyors to more quickly assess the quality of data acquired, while empowering them to modify their data gathering plans on the fly, based on the information they gather.

This would allow for extremely rapid assessments of an area's potential in terms of hydrocarbon extraction, shortening the length of time necessary for allocation to surveying work and allowing extraction to commence sooner.

Technological solutions lessening human and environmental impact

A major factor informing the METIS project's progress has been the reduction of its environmental footprint.

For example, the use of AI-powered autonomous drone systems allows for the deployment of DARTS from above the tree line, reducing the need to clear forests and interfere with extant ecosystems. The DARTs themselves are also made from biodegradable materials. Their bodies are made from polylactic acid, which is a type of biodegradable plastic.

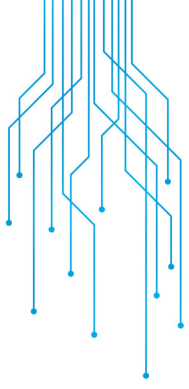
Research teams have also ensured that almost every component of the DARTs will have a negligible environmental footprint, due to the use of advanced printed and hybrid electronics and biopolymers.

Furthermore, command-and-control processes for the METIS project are directed from multi-purpose inflatable airships called Flying Whales, which transport all equipment for sourcing seismic data, along with any materials required to set up camps in the survey area.

Once operations are concluded, autonomous drones will be tasked with seeding camp areas with seeds from indigenous plant-life in order to fully decommission these areas and preserve the local ecosystem.

The fact that mitigation measures are specifically included at every step of the development and deployment process to avoid impacting the environment shows that AI can be more than just an efficiency tool. It can also help contribute to more sustainable business practices.

Overall, the existence of METIS and its proven viability as a seismic data gathering platform are a promising indication of AI's ability to reduce risks to humans and impact on the environment, while improving accessibility to isolated and inhospitable parts of the world.



Peru

AI helps archaeologists decode and preserve ancient geoglyphic etchings

Peru’s Nasca Lines have intrigued archaeologists since they were first studied nearly a century ago. Scratched on the surface of the ground between 500 B.C. and A.D. 500, these □ geometric figures depict living creatures, stylized plants, and imaginary beings, as well as geometric figures several kilometers long.

A total of 300 geometric figures have been identified thus far, though archaeologists remain unsure as to their exact purpose.¹³¹ For some, they represent astronomical observations, while others think they may hold coded messages to communicate with deities of the time.¹³² Others still have theorized everything from aliens to supernatural forces.¹³³

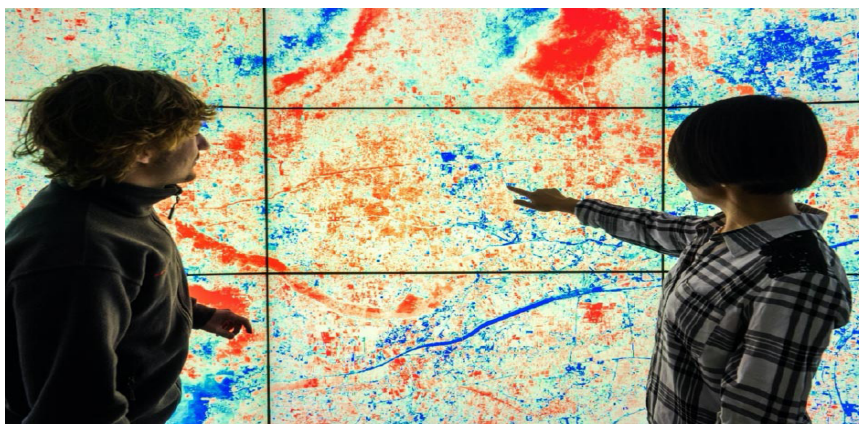
A key difficulty for scientists is the fact that some of these etchings are 370 meters long, which makes studying them at ground-level very difficult. But studying them from above is not much easier – the area to survey is extremely vast and the natural erosion of the surroundings mean the lines and patterns are not always clearly visible.

Using AI to overcome human limitations

A team of researchers from Japan’s Yamagata University has used deep-learning to increase its observational and analytical capabilities – effectively improving the way it identifies, interprets, and preserves the geoglyphs.¹³⁴

Working with IBM Research, the team uses a cloud platform to stitch together massive amounts of geospatial data, including lidar, drone, and satellite imagery and geographical surveys, to create high-fidelity maps of search areas.

Covering new ground with AI



Source: IBM / Yamagata University

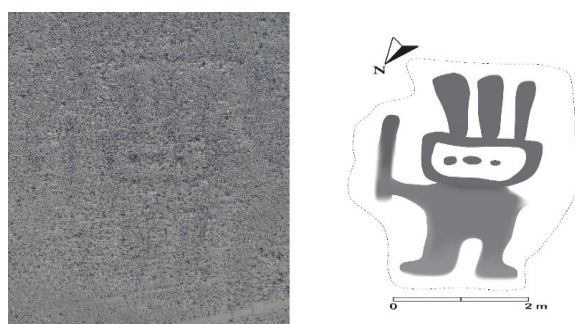
Neural networks are then trained to recognize data patterns of known shapes to uncover new ones. This exercise proved harder than expected, as each of the 100 biomorphic geoglyphs identified so far is fairly unique – making it difficult for the AI algorithm to learn what to look for when tracking down hidden shapes.

According to Professor Masato Sakai, leader of the project, the team had to “specifically build techniques in the deep-learning framework to learn and distinguish between these different patterns and sizes of the geoglyphs.”¹³⁵

Breaking new ground faster than before

Despite the obstacles, the exercise paid off. During the testing phase, the AI discovered a new design – a small humanoid figure that had been missed in previously collected data. The discovery took only two months, as opposed to the several years that previous methods had required.

Finding a new geoglyph



Source: IBM / Yamagata University

Professor Sakai notes that it is a “major achievement to find a new geoglyph in an area that was often investigated.”¹³⁶

These exciting breakthroughs are just the start of more work that can now be done using AI.

“This technology and these efforts are expected to promote understanding of all the Nasca Lines as a whole, and accelerate research and awareness towards activities to protect this World Heritage Site,” write the researchers.¹³⁷

From discovery to preservation

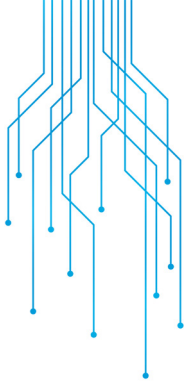
The use of AI to quickly and precisely identify geoglyphs is important to not only understand the vast extent and complexity of the Nasca Lines, but also to ensure they can be preserved for future generations.

“The expansion of urban areas in the Nasca region risks damaging the lines,” write the researchers. “There is an urgent need to gain an accurate understanding of the geoglyphs’ location and distribution so that they can be adequately protected.”

Declared a UNESCO World Heritage site in 1994, the Nasca Lines risk being destroyed if they are not quickly and precisely mapped out.

“The most important point is not the discovery itself,” says Professor Sakai. Indeed, “gaining a detailed understanding on the worldview of the people who made and used these geoglyphs” is one side of the equation; the other is the fact that making them more visible should ensure they are “protected as important cultural heritages.”

In this context, the AI serves as a tool to communicate across generations; communication between the people who created the geoglyphs and us finding them now, and communication between those working to preserve them today and future generations who will be able to learn about them.



The Philippines

Engineering student uses AI to communicate with aphasic patients

Locked-in syndrome (LIS) is a rare neurological disorder that causes a severe paralysis of voluntary muscles, resulting in total loss of motor ability, including speech. A form of aphasia, LIS leaves patients unable to formulate language because of damage to specific brain regions.¹³⁸ In many cases, the patients are fully conscious and aware of the world around them, but the only physical functionality they have left is the ability to blink or move their eyes in vertical motions – hence, they are ‘locked inside’ their own bodies.¹³⁹

LIS can be a result of traumatic brain injury, neural damage, or stroke – making it impossible to detect ahead of time or even treat. While partial recovery of muscle control is possible, physical therapy, nutritional support, and prevention of complications such as respiratory infections are often the only way LIS patients can be helped.

It is estimated that LIS affects about 1% of all people who have suffered a stroke.¹⁴⁰ In the Philippines, strokes are the second leading cause of death,¹⁴¹ representing close to 14% of all deaths in 2018 alone.¹⁴² For this reason, LIS is a major health risk for the 35% of the total population suffering from some form of cardiovascular disease in the Philippines.¹⁴³

In 2019, a group of Electronics Engineering students University of Santo Tomas, led by Jay Patrick M. Nieves and supervised by Engr. Seigfred V. Prado, M.Res. NT, M.Sc. ELEG, proposed an experimental brain-computer typing interface that leverages AI to communicate with patients suffering from LIS and improve their quality of life.¹⁴⁴

Scanning and coding brain signals

There are many systems that help patients overcome their physical limitations to activate voice boxes, virtual keyboards, and wheelchair-controlling programs. But to work properly, these systems require patients to hold their gaze in a stable and consistent manner.

In the case of LIS patients, eye movements tend to be unstable and inconsistent, which means they cannot accurately translate patients’ intentions. Instead of relying on unpredictable physical cues, Jay Patrick M. Nieves’ system is based on reading accurate and reproducible brain signals.

The first step was to get patients to imagine basic geometric shapes and letters. Using Electroencephalogram (EEG) scanners, their brain signals were recorded every time they ‘saw’ shapes and letters in their minds. A machine-learning algorithm was then deployed to identify, classify, and organize the brain signals according to their corresponding shapes or letters.

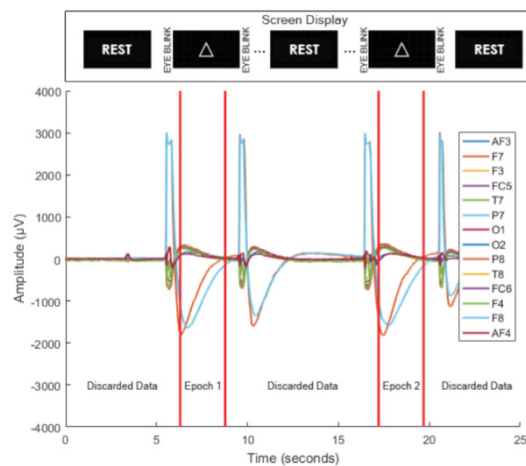
EEG data is usually decoded through a three-step data-processing mechanism, followed by feature extraction and classification methods – a long and complicated process that must be

examined and overseen by brain imaging experts every step of the way.

In this case, the deep learning model allows the EEG signals to be decoded from the raw data in a completely autonomous manner. In doing so, the AI system not only allows the second and third steps of the traditional process to be combined – streamlining steps and reducing reliance on expert knowledge – but also helps achieve more accurate results.

In another study, Nieles and team demonstrated that the decoding of EEG signals using deep learning yielded an accuracy and precision rate of 89.44% and 90.51% respectively, compared to the traditional process, which demonstrated lower accuracy and precision rates of 83.06% and 83.73%.¹⁴⁵

Brain Signals Visualized through EEG



Source: Jay Patrick M. Nieles

Transforming thoughts into actions

The second step in this process is the transformation of processed brain signals into words and commands. The brain scans are collected and organized into a personalized 'glossary' of brain waves that translate a specific signal into a specific shape, letter, or command – effectively allowing patients to communicate a word or idea just by thinking about them.

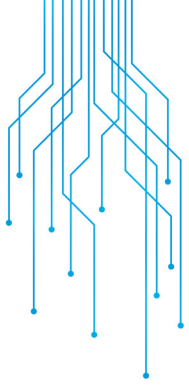
If, for example, the brain signal for a triangle shape is associated to the word 'thirsty', then a LIS patient can quickly and clearly communicate a need by thinking of a triangle. Likewise, after some training the patient can spell out entire words letter by letter, thinking of them in sequence and in line with the pre-defined collection of categorized brain signals.¹⁴⁶

The study is one of the first to leverage the electrical impulses created by one's thinking, demonstrating that AI can help turn abstract, intangible signals into real and concrete actions.

Fostering brain-AI synergies

If prototyped and developed at scale, the system could help the hundreds of thousands of people affected by locked-in syndrome worldwide, as well as open new doors for research on AI-brain synergies. Indeed, this specific use case focuses on typing interfaces, but there is no reason it could not be applied to other types of platforms.

AI algorithms that allow cognitive activity to be decoded into synthetic speech or text can help transform the way humans and machines communicate with each other. For example, they can improve the way robotic limbs are controlled through brain waves,¹⁴⁷ or even accelerate the treatment of a range of neurodegenerative conditions.¹⁴⁸



Russia

RDIF and State Hermitage showcase the creative potential of AI

AI is at the vanguard of disruptive developments across all sectors of the economy, including those revolving around creativity. From systems that beat expert players at games of chance¹⁴⁹ and strategy¹⁵⁰ to solutions that detect written tones¹⁵¹ and non-verbal cues,¹⁵² AI is rapidly gaining contextual, situational, and emotional awareness.

This shift is allowing AI to expand its horizons, disrupting imagination-driven activities such as creative writing,¹⁵³ music composition,¹⁵⁴ and visual arts.

In 2019, the Russian Direct Investment Fund (RDIF) and the State Hermitage Museum in St Petersburg held Russia's first major international art exhibition featuring AI-created artworks that question the very notion of creative intelligence and expression.

The exhibition is also one of the first attempts to properly explore the use of AI in art, and was intended, in the words of State Hermitage CEO Mikhail Piotrovsky, to demonstrate "how modern technology can be made more human."¹⁵⁵

Using algorithms to mimic human creativity

Artists at the exhibition used an assortment of AI-derived techniques and technologies, but a common trait was the use of Generative-Adversarial Network (GAN) algorithms. GAN algorithms were designed in 2014, and are growing in use in fashion, astronomy, and aeronautics for their ability to reliably predict and synthesize images using training data.

In the art sector, they were notably used in the generation of the Portrait of Edmond Belamy, which in 2018 became the first ever AI-generated piece of artwork to be auctioned at Christie's auction house – for USD432,500.¹⁵⁶

Obvious Art Group's Portrait of Edmond Belamy



Source: Christie's

The basic principle of a GAN algorithm is that it relies on two AI networks that compete with one another – a generative versus a discriminative network. Both networks are trained on a shared set of image-based training data, after which the generative network is tasked with creating new images that the discriminative network must identify and eliminate.

The discriminative network thus becomes a training device for the generative network, which learns when an image it creates is not identified by the discriminative network and adjusts its generative algorithm to achieve more consistent results.

GAN algorithms enable machines to mimic human imagination and critical thinking by forcing them to learn from failed attempts and find new approaches to address parameters established by their programmers.

AI-powered intercultural exchange

Represented at the event were AI artists from around the world, including the People’s Republic of China, France, Germany, Italy, Japan, Russia, Saudi Arabia, and Turkey. Each artist, or team of artists, brought with them new and unique expressions of AI-powered art, which were each often inflected by distinct cultural traditions.

Paris-based AI art group Obvious Art three portraits developed by training GAN algorithms on 15,000 paintings from the 14th to 19th centuries. Saudi artist Lulwah Al Homoud conceptualized an AI art piece centered around the core thematic element of the Arabic alphabet.¹⁵⁷ Being and Existence addresses the relationship between language and emotion by using an AI algorithm to develop an abstract variation of Arabic.

Lulwah Al Homoud’s Being and Existence



Source: Saudi Aramco

Drawing inspiration from disparate aspects of European art and architecture, Italy’s Davide Quayola and Turkey’s Refik Anadol brought imaginative GAN algorithm-based installations.¹⁵⁸ Quayola’s work sought to represent the AI “view” of French impressionist paintings, while Anadol’s Machine hallucinations was created by training an advanced GAN algorithm on over 100,000 photographs of Gothic and modern architecture.

Also represented was the People’s Republic of China’s Sun Xun, who trained an AI to create an animated film called Time Spy by exposing it to images of 10,000 hand-carved wood-cut images. This drew on both the artist’s affinity for the woodcutting traditions native to the People’s Republic of China itself, as well as the European woodcutting traditions established by the German Renaissance artist Albrecht Dürer.¹⁵⁹

Sun Xun's Time Spy



Source: Edouard Malingue Gallery

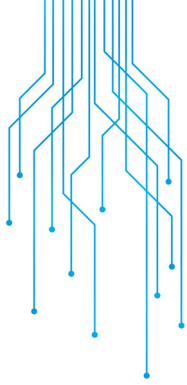
Opening new horizons for AI

GAN algorithms are a powerful indication of AI research going well beyond traditional scientific and economic boundaries, enabling major advancements in human-like behaviors and characteristics.

The fact that AI-enabled art can be showcased and appreciated proves that AI can be much more than just a productivity-enhancing tool; it can contribute to facilitating human expression and communication across cultural and linguistic boundaries.

More broadly, the very existence of such an endeavor suggests that the general public may be warming to the idea of AI being more present in different facets of their lives.

Indeed, a major barrier to wider adoption of AI in mainstream applications has been users' reluctance to integrate something they perceive as "impenetrable" into their day-to-day activities. In this context, it may very well be that the more situationally aware and emotionally reactive AI becomes, the easier it will be for people to accept and trust the wide range of AI-enabled systems currently in the making.



Singapore

Visa tailors customer experiences with AI-enabled recommendations

The prominence of hyper-connected digital devices and ultra-personalized digital platforms is changing the relationship between company and customer. As consumers face more choices and industries are rapidly commoditized, it is no longer enough to provide the right product to the right person at the right price; customers want unique, tailor-made experiences that anticipate their needs and adapt to their expectations.

In this context, AI is well positioned to help organizations adapt their offerings to rapidly changing customer dynamics.

From voice assistants to chatbots, consumers are already growing accustomed to interacting with automated systems that guide them in their purchasing decisions. And this trend will intensify as AI is expected to power 95% of all customer interactions, including live telephone and online conversations, by 2025.¹⁶⁰

Banks, for instance, are already using chatbots to provide 24-hour assistance. Nina, Swedbank's AI, is trained to learn what customers want and how best to help them by cross-referencing website searches and contact center enquiries.¹⁶¹ In Singapore, Visa is using AI to leverage transaction data to personalize product recommendations – effectively bridging the physical and digital worlds in highly interactive and immersive ways.

Visa's Travel Predict personalizes recommendations

Visa's Travel Predict is a recommendation engine that uses past transactional behavior to help issuing banks identify the credit and debit cards that are likely to be used for travel.

Using transaction data, Travel Predict generates travel propensity scores to predict which Visa card will be used for international spend in the next 30 to 90 days. Issuing banks then consider these scores, together with other factors, such as the success of their past card promotions, to identify the best candidates for travel-related marketing.

Not only does the AI solution's scoring system help banks maximize the success of their marketing campaigns, the development and deployment of the solution is underpinned by a transparent and responsible AI.

Incorporating fairness and transparency into AI models

Visa's Travel Predict was designed to ensure its models capture new trends, keep predictions accurate, and provide fair and unbiased recommendations.

For example, it takes into account the seasonality of travel data, ensuring that data gathered

in a given season does not skew a recommendation made in a different season. Further, Visa's internal governance framework ensures that card issuers are not given quantitative or qualitative information that would give them a competitive advantage by knowing how competitors' recommendations are faring.

In addition, Visa documents the technical standards, data inputs, model explanation and interpretation, methodology, fairness, and quality/accuracy questions, and shares its general AI methodology with issuing banks so that they can check the model's quality and suggest potential improvements.

AI Governance Framework

In Singapore, the Monetary Authority of Singapore (MAS)¹⁶² and Personal Data Protection Commission (PDPC)¹⁶³ have both issued guidance documents that require that decisions by AI are made in a transparent, fair, and explainable manner.

The PDPC lists the following four areas to consider for the responsible use of AI:

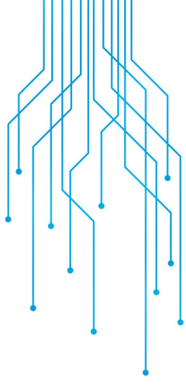
1. Internal governance structures and measures
2. Determining the level of human involvement in AI-augmented decision-making
3. Operations management; and
4. Stakeholder interaction and communication.

Visa's Travel Predict employs a "human-over-the-loop" approach, which the PDPC defines as one that allows users to play a supervisory role, giving them the ability to take over decision-making when the AI encounters unexpected scenarios.

Under the PDPC's framework, this approach is applicable to AI solutions assessed to have a medium level of severity and probability of harm on users, should the AI make a wrong decision.

In the case of Travel Predict, a degree of human intervention is involved in the AI decision-making process by allowing the model provider (Visa) to track the accuracy and quality of related metrics at an aggregate level during the AI model selection, training, and validation phase. Meanwhile, the model deployer (the issuing bank) performs the final filtering and assessment to decide which cardholders receive a given offer.

Public confidence and trust are key factors for the rising adoption of AI tools, and so it is important that AI-enabled services integrate privacy and responsibility principles. All parties involved in the adoption and implementation of AI products and solutions have a responsibility to ensure that public trust is not compromised.



Chinese Taipei

Momo.com meets B2C demand with smart logistics, warehousing solutions

The digital economy is one of the most important drivers of economic growth and competitiveness today. Across markets, a range of digital platforms and devices allow consumers to access just about any product or service from the comfort of their own home. Exacerbated by the ubiquity of mobile devices and mobile applications, e-commerce sites have proliferated in the last decade. It is not uncommon nowadays to find at least two local e-commerce companies in each market, in addition to the usual international giants.

Chinese Taipei's Momo.com Inc (MOMO) has steadily grown in the digital space since first providing mail-order purchases in 2005. As of today, it is among Chinese Taipei's largest business-to-consumer (B2C) platforms, offering everything from beauty and household products to home and travel insurance.¹⁶⁴

Like other e-commerce platforms, the rise of MOMO is largely due to the widespread digitization of human activity, generating the kind of massive data sets necessary to know and understand their customers. Browsing habits, purchase preferences, transaction history – a range of data points need to be captured behind the scenes so that digital platforms can improve and personalize customer experiences.

In the case of MOMO, data is the invaluable resource that allows it to efficiently meet consumer demand for quick delivery of purchases amidst increasingly complex supply chains.

Using AI for a unique view on patterns and trends

Since 2017, MOMO uses AI algorithms and data analytics to improve its understanding of patterns in customers' purchasing habits, of intertwined supply and demand factors, and of the optimal allocation of logistical resources.

MOMO's Smart Logistic System aggregates data points, taking demand factors – (i) product brand and type; (ii) consumption volumes and frequency; and (iii) customer demographics and location – into consideration with supply factors – (i) warehouse capacity; (ii) inventory levels; (iii) marketing events; and (iv) delivery schedules.

This exercise allows it to model patterns in supply and demand, effectively predicting future shopping behaviors and purchasing trends. This gives MOMO a unique edge, as it can streamline the entirety of its logistics processes for an intelligent logistics delivery system, thus enabling quick and effective response to customer demand.

Making logistics more agile and resilient

The AI system helps improve four key aspects of MOMO's business operations:

1. Creating the optimal warehouse product configuration to reduce delivery times

Developed to facilitate express delivery, the AI algorithm optimizes warehouse inventory based on product classification, vendor, brand, and other attributes – while also taking into consideration warehouse capacity and transportation schedules – for an efficient and flexible allocation of vendors’ products to satellite warehouses in different locations, at optimized volumes.

2. Multiple data points allow for informed stock-replenishment decisions

MOMO’s AI-based replenishment model analyzes customers’ orders, their profiles, and online behavior, as well as information on the company’s own inventory levels and shopping events, to generate recommendations to vendors on when and where to replenish stock. This allows them to send their products directly to the satellite warehouses that need replenishing, and reduces routing costs and optimizes inventory management with fewer items needing to be housed in the main storage facility.

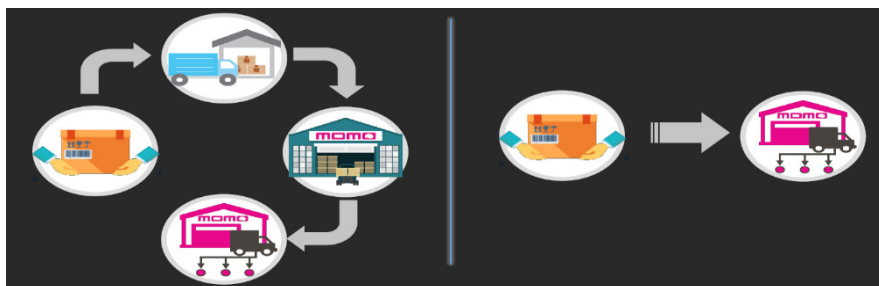
3. Strengthening warehouses’ ability to respond to temporary surges in demand

Sales, promotions, and other marketing events on MOMO’s platforms can lead to temporary surges in customer demand. Keeping track of and responding to these events on their own can be challenging for warehouse and delivery systems. MOMO’s real-time ‘hot sales’ prediction model uses sales forecasts, inventory changes, and delivery volumes to help main warehouses prepare for surges and adjust inventory levels and schedule distribution to satellite warehouses in advance.

4. Achieving cost-efficiency in last-mile delivery

MOMO has deployed numerous small satellite warehouses across the island. These are strategically located in the periphery of major customer shipping locations. However, to streamline last-mile delivery from satellite warehouses to the customer, MOMO has created a ‘satellite warehouse logistic and distribution area analysis module’ to determine the most cost-effective delivery route to use for express delivery. Using customer addresses, popular delivery locations, and distribution area simulations, the AI algorithm generates the shortest delivery route possible and recommends it to MOMO’s delivery drivers.

Momo.com Inc’s smart warehouse system: AI streamlines 4-step process to a direct distribution model



Source: Momo.com Inc.

AI adoption can mitigate against future supply chain disruptions

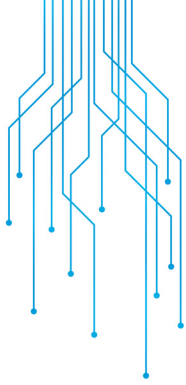
The impact of adopting this smart warehouse system has been substantial. On the frontlines, MOMO express delivery has reduced delivery time to less than 6 hours, limited overhead costs, and increased customer satisfaction. Behind the scenes, using AI to determine how inventory should be best allocated across its satellite warehouses has allowed MOMO to increase its express delivery volume by 500%.

These are major benefits in and of themselves, but they have proven especially invaluable during the COVID-19 crisis. The empty grocery shelves and medical supply shortages witnessed across the world highlighted the importance of smart supply chain management that not only responds to sudden demand surges, but also takes proactive steps to suggest the best measures to take in advance.

Predictive AI, which can help retail and logistics industries anticipate which items would be needed during a crisis, is one example of an AI application that will help businesses prioritize the supply of certain items and reduce the chain effects and other negative consequences of panic buying.

MOMO credits its ability to cope with the unanticipated COVID-19 led spike in consumption to its smart warehousing system. Demand for large volumes of toilet paper, which are bulky and ties up logistics capacity, would have restricted movement of other anti-epidemic products and necessities. Using predictive AI, MOMO was able to distribute toilet paper directly to its satellite warehouses, which could then be quickly delivered by last-mile delivery, eliminating the need to store it while waiting for transport schedules between main and satellite warehouses to match up, and preventing orders of toilet paper from jamming the flow of other goods.¹⁶⁵

In this context, the use of AI in logistic networks can address supply chain vulnerabilities and help prepare for future disruption, thus supporting broader economic dynamism and resilience.



United States

TranslateLive and Descript facilitate communication with language-processing AI

Of all the types of AI currently in use, none has become so ubiquitous – and yet remains so invisible – as natural language processing (NLP).

From chatbots that automatically respond to customer service queries to virtual assistants that recognize and obey voice commands, the field dedicated to enabling computers to work with human language has greatly advanced in just the last decade. But, as several innovations being rolled out demonstrate, there is still much room to grow.

TranslateLive¹⁶⁶ and Descript¹⁶⁷ are two companies pushing the boundaries of distinct but complementary facets of NLP: one uses it to overcome language barriers (translation), while the other goes beyond the confines of oral communication (transcription).

Overcoming language barriers

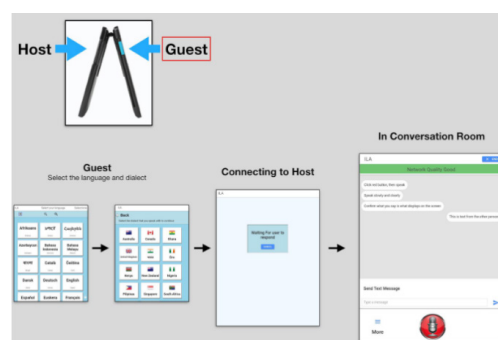
Based in Florida, TranslateLive allows two people who do not speak the same language to communicate via real-time speech-to-text conversion and translation without having to download a separate application.

The TranslateLive platform uses Compute Engine, Translation API, and Cloud Speech-to-Text to drive its live translation features.

Compute Engine provides the necessary performance and scalability for real-time translation without latency issues, while Translation API and Cloud Speech-to-Text handle additional translation needs within the TranslateLive browser tool and mobile application.

Google language intelligence also helps TranslateLive understand and accurately translate different accents, while Google Cloud Platform infrastructure lets TranslateLive focus on overall development instead of small, but time-consuming tasks such as setting up local servers.

Real-time, in-app translation on the ILA device



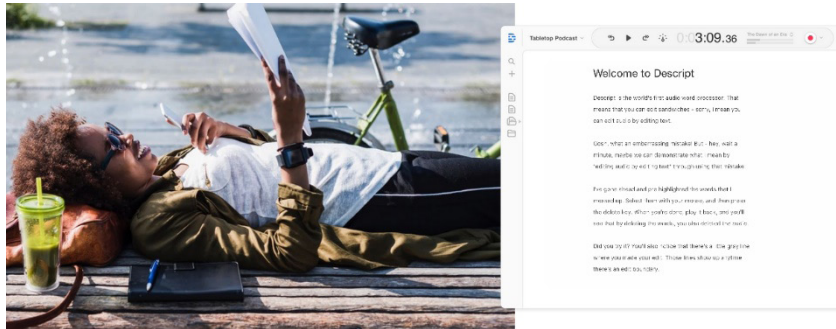
Source: TranslateLive

Going beyond the spoken word

Descript offers an AI-enabled application that syncs audio to automated transcripts and provides easy editing capabilities. From legal proceedings to entertainment content, quickly and accurately transcribing audio materials is a time-consuming job.

Many automated programs exist, but they tend to be limited by the quality of the original audio source; from distracting background noises to mumbling speakers, there are many factors affecting audio clarity and hence the quality and accuracy of the transcription. To provide the highest possible level of word accuracy, Descript uses the REV engine to recognize speech and edit transcriptions in real time.

Fast and accurate transcription of audio files



Source: Descript

Enabling cooperation across cultures and territories

The services offered by both TranslateLive and Descript provide immediate and tangible benefits to a wide range of users and organizations.

TranslateLive is a cost-effective platform for non-profits and other non-governmental organizations to enhance internal and external communications in different languages. Call-center agents also use the service to speak with customers in different languages, preventing any potential miscommunications or misunderstandings.

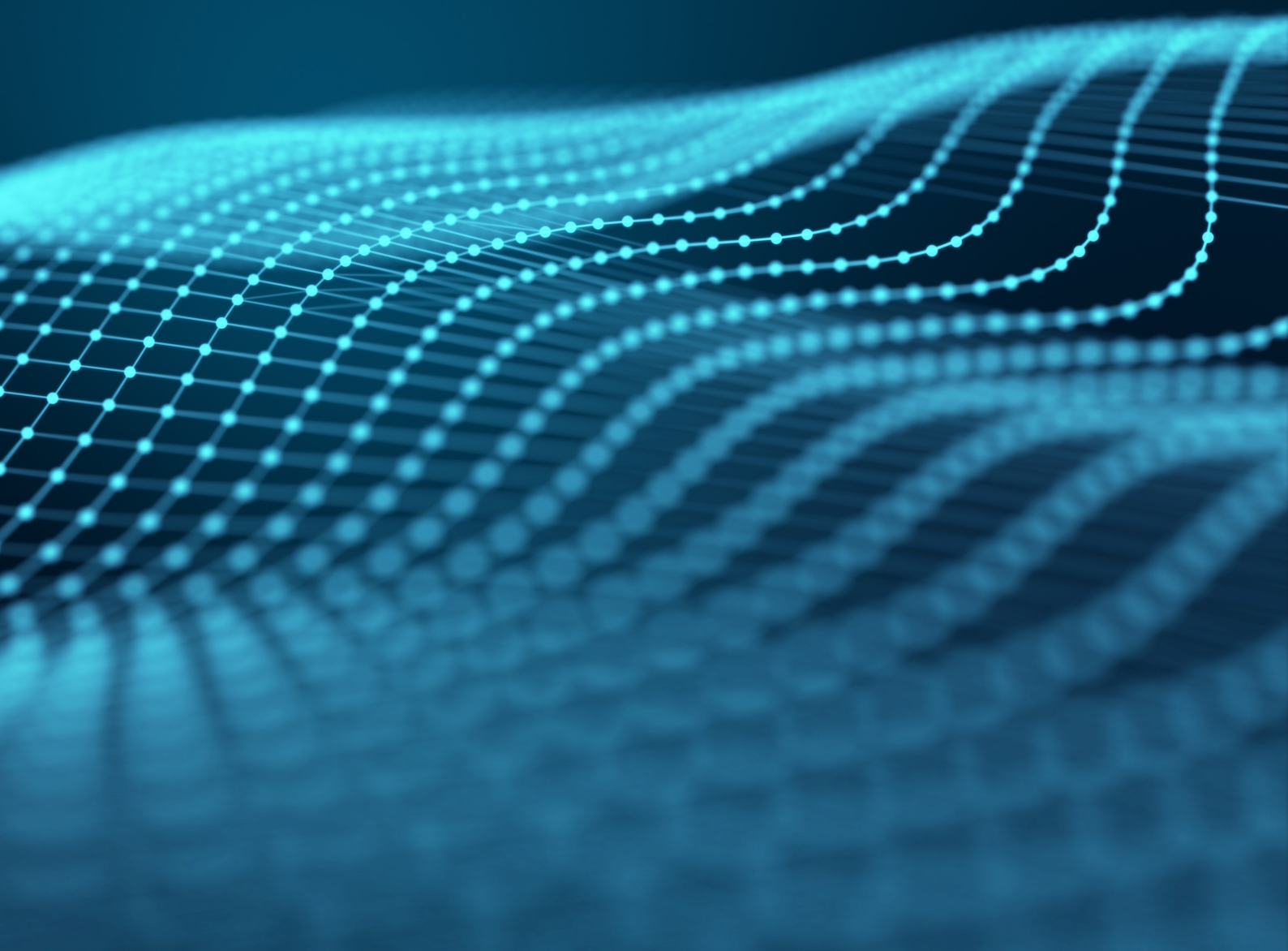
TranslateLive's sister company VTCSecure also works in the deaf communications space and is exploring further applications with accessibility-friendly benefits.

Meanwhile, Descript limits costs, improves workflows, and reduces error margins for a range of content producers who need fast and accurate transcriptions (journalists, radio stations, legal departments). The company is also testing context-aware recognition to improve contextual speech recognition, providing specific jargon glossaries for different industries.

Beyond these applications, both TranslateLive and Descript are redefining the way people create and interact with voice- and audio-based media – pushing the boundaries of cross-cultural, cross-border, and cross-platform communications for the long-term betterment of societies and economies.

ANNEX 2

**Summary of Domestic AI Strategies,
Agencies, and Initiatives**

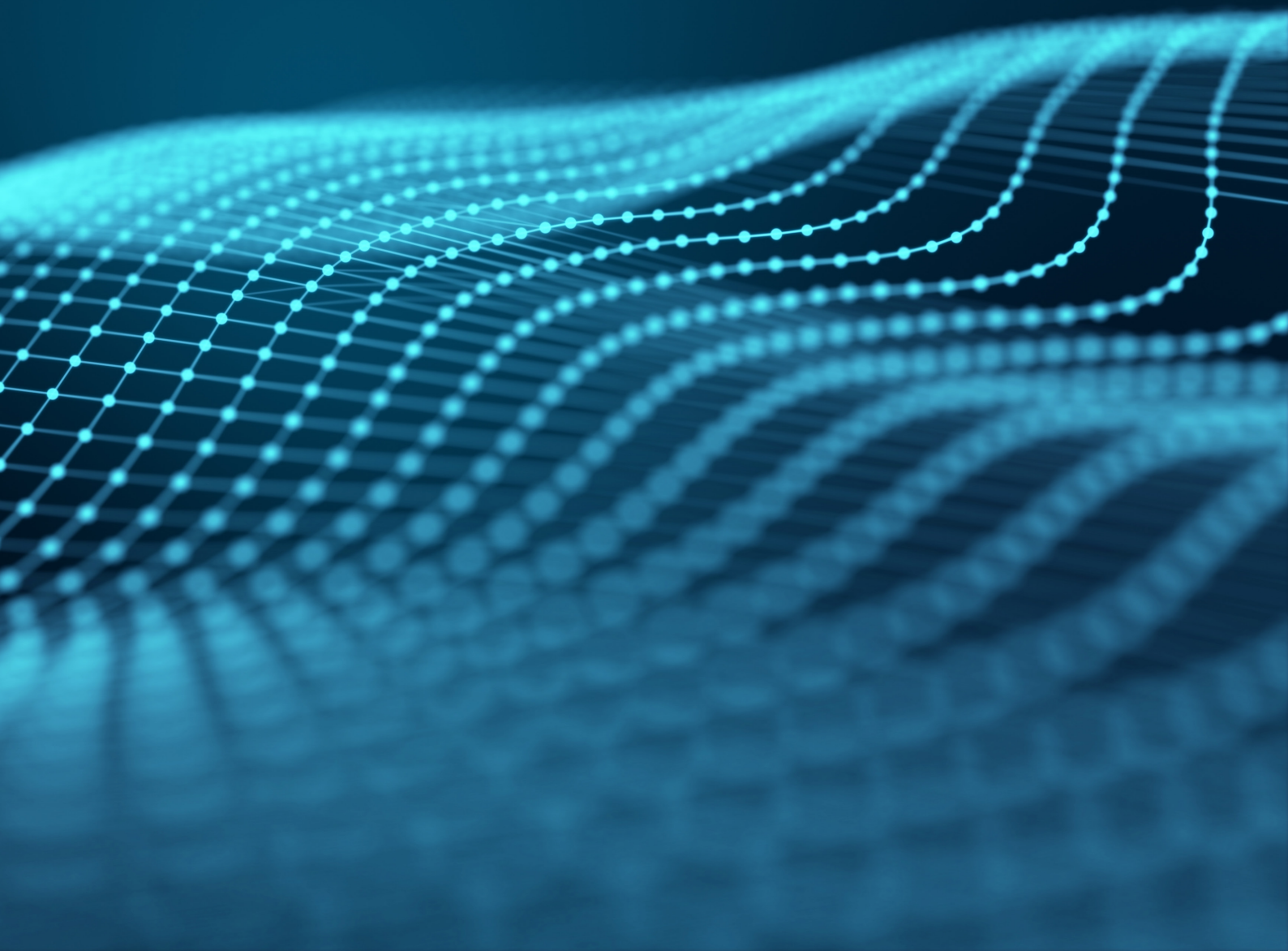


APEC Economy	Main AI Strategy	Key AI Agency	Notable AI/Data Initiatives
Australia	- Australia 2030 - Australian Technology and Science Growth Plan	- Data61 - Commonwealth Scientific and Industrial Research Organization (CSIRO)	- AI Ethics Framework - Code for The Responsible Conduct of Research - AI Standardization Roadmap / AI Technology Roadmap - Humanizing Machine Intelligence (HMI) project - Digital Economy Strategy
Brunei Darussalam	None for AI	None for AI	- Wawasan 2035 - Digital Government Strategy (2015 - 2020) - E-Government National Centre (EGNC)
Canada	Pan-Canadian Artificial Intelligence (AI) Strategy	- Canadian Institute for Advanced Research (CIFAR) - Alberta Machine Intelligence Institute - Vector Institute - Montreal Institute for Learning Algorithms (MILA)	- Algorithmic Impact Assessment (AIA) - Directive on Automated Decision-Making - Global Partnership on Artificial Intelligence (GPAI) - Innovation Superclusters initiative
Chile	National Artificial Intelligence (AI) Policy (forthcoming, announced September 2019)	- Ministry of Science, Technology, Knowledge, and Innovation - Expert Committee for a National AI Policy and Action Plan	- Artificial Intelligence Working Plan
People's Republic of China	Next Generation Artificial Intelligence Development Plan	- Ministry of Science and Technology (MOST) - AI Plan Promotion Office	- Internet Plus Artificial Intelligence Plan (2016-2018) - Three-Year Action Plan for Promoting Development of a New Generation Artificial Intelligence Industry (2018-2020) - AI Innovation Action Plan for Colleges and Universities - Beijing AI Principles
Hong Kong, China	None for AI - Smart City Blueprint for Hong Kong - 2018-2019 Budget	- Government CIO Office (GCIO) - Hong Kong Development Bureau - Innovation and Technology Bureau (ITB) - Artificial Intelligence Society of Hong Kong - AI Specialist Group (Hong Kong Computer Society) - Hong Kong Science and Technology Parks Corporation (HKSTPC) - Hong Kong Applied Science and Technology Research Institute (ASTRI)	- Ethical Accountability Framework - SFC Guidelines on AI Algorithms and Robo-Advisors - Consultancy Study on Smart City Blueprint for Hong Kong (report) - Reshaping Banking with Artificial Intelligence (whitepaper) - Hong Kong-Shenzhen Innovation and Technology Park - Smart Government Innovation Lab
Indonesia	National AI Strategy	Agency for the Assessment and Application of Technology (BPPT)	- Making Indonesia 4.0 - Tokopedia AI Research Centre - NVIDIA AI R&D Centre - Indonesia AI Forum on Data Privacy and Protection
Japan	Artificial Intelligence Technology Strategy	Strategic Council for AI Technology	- Society 5.0 - Roadmap for the Industrialization of Artificial Intelligence - Draft AI R&D Guidelines for International Discussions
Malaysia	National AI Framework (forthcoming, announced in 2018)	Malaysia Digital Economy Corporation (MDEC) (proposed but unconfirmed)	- Industry Digitalization Transformation Fund (2019 budget) - National Big Data Analytics Framework - Data Free Trade Zone (DFTZ) - National Policy on Industry 4.0 (Industry4WRD)
Mexico	None for AI	- Office for the Coordination of National Digital Strategy (CEDN) - National Council of Science and Technology (Conacyt)	- IA2030 Coalition - National Digital Strategy (NDS) - Program for the Development of the Software Industry (PROSOFT) and Innovation
New Zealand	Artificial Intelligence: Shaping a Future New Zealand (Guiding report)	AI Forum	- Data Ethics Advisory Group - Algorithm Assessment Report - Algorithm Charter (draft)
Papua New Guinea	None for AI	None for AI (but the Department of Communication and Information Technology is launching several public-sector digitalization projects)	- World Health Organization (WHO) AI-enabled polio outbreak response - Several smart agriculture / agritech projects

Peru	None for AI	None for AI (but the Secretaría de Gobierno Digital, Ministry of Digital Government, could take a lead)	<ul style="list-style-type: none"> - IA-ckatón Red Gealc (AI Hackathon, government/IDB event) - CenturyLink Forum 2019 on Digital Transformation for Businesses - Decreto Legislativo N° 1412 (2018; law on digital identities, digital services, digital architectures, interoperability, cybersecurity, and data protection) - Laboratorio de Gobierno y Transformación Digital (Government Lab for Digital Transformation) - Plataforma Nacional de Datos Abiertos (National Open Data Platform)
The Philippines	AI Roadmap (forthcoming, announced July 2019)	AI Taskforce (coordinated by the Department of Trade and Industry, DTI)	<ul style="list-style-type: none"> - Filipinnovation and Entrepreneurship Roadmap - Digital Transformation Strategy 2022 - PhilHealth Digital Transformation 2017-2022 - Cloud First Policy - National ICT Ecosystem Framework (NIEF) 2022 - National Government Data Centre (NGDC)
Russia	National Strategy for the Development of Artificial Intelligence (NSDAI)	Government Commission on Digital Development and the Use of Information Technology to Improve the Quality of Life and the Conditions for Doing Business	<ul style="list-style-type: none"> - National AI Centre - National Technology Initiative - Skolkovo Innovation Cluster
Singapore	National AI Strategy	<ul style="list-style-type: none"> - AI Singapore - National AI Office 	<ul style="list-style-type: none"> - Autonomous Vehicle Rules - Principles to Promote Fairness, Ethics, Accountability, and Transparency (FEAT) in the Use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector - Advisory Council on the Ethical Use of AI and Data - Program on the Governance of AI and Data Use - Proposed Model AI Governance Framework
Republic of Korea	<ul style="list-style-type: none"> - National Strategy for Artificial Intelligence (2019) - Development Strategy for Data Economy and Cloud Industry in preparation for the AI Era (2020) 	Ministry of Science and ICT (MSIT)	<ul style="list-style-type: none"> - I-Korea 4.0 (2018-2022) - Artificial Intelligence Information Industry Development Strategy - Mid to Long Term Master Plan in Preparation for the Intelligent Information Society - AI R&D Strategy - Data and AI Economy Revitalization Plan (2019-2023) - 6th National Informatization Master Plan (2018-2022)
Chinese Taipei	<ul style="list-style-type: none"> - AI Action Plan - AI Strategy 	<ul style="list-style-type: none"> - AI Taiwan - Ministry of Science and Technology (MoST) 	<ul style="list-style-type: none"> - AI for Industrial Innovation - AI International Innovation Hub - AI Talent Program - Test Fields and Regulatory Co-creation - Hsinchu AI Business Park
Thailand	None for AI	<ul style="list-style-type: none"> - Ministry of Information and Communication Technology (MICT) - Ministry of Digital Economy and Society (MDES) 	<ul style="list-style-type: none"> - Thailand 4.0 - AI for Social Good - Digital Park Thailand - Ethical Guidelines for AI (draft) - Thai People Map and Analytic Platform (TPMAP)
United States	American AI Initiative	National Science and Technology Council (NSTC) Select Committee on Artificial Intelligence	<ul style="list-style-type: none"> - Executive Order on Maintaining American Leadership in Artificial Intelligence - National AI R&D Strategic Plan - AI Strategy (Department of Defense) / AI Strategy (Air Force) - White House Summit on Artificial Intelligence for American Industry
Viet Nam	National AI Strategy (forthcoming, announced January 2019)	<ul style="list-style-type: none"> - Ministry of Information and Communications - Ministry of Planning and Investment - Ministry of Science and Technology 	<ul style="list-style-type: none"> - National Digital Transformation Strategy To 2030 - National Program for Using IT in the Operations of State Agencies (2016-2020) - Draft Architecture Framework for e-Government of Viet Nam (version 2.0) - National Databases Decision No.714/QD-TTg - ICT Reference Framework for Smart Cities (version 1.0)

Source: TRPC Research

ANNEX 3



In addition to making AI a domestic priority, all 21 APEC economies are engaged in at least one of the many AI frameworks launched by regional, international, and multilateral organizations in which they are members. While these commitments run parallel to each other, they are often complementary in the way they seek to drive AI adoption and development in different levels of the economy.

Asian Development Bank (ADB)

The ADB – of which Australia, Brunei Darussalam, Hong Kong, China, the People’s Republic of China, Indonesia, Japan, Malaysia, New Zealand, Papua New Guinea, the Philippines, the Republic of Korea, Chinese Taipei, Thailand, and Viet Nam are members – does not have a distinct framework for AI, but it is facilitating its growth and development in three complementary manners.

First, it is helping Asia-Pacific (APAC) economies leverage digital technologies by including their access and use in as many ADB-driven development projects as possible. Launched in 2018, the Digital Technology for Development Unit¹⁶⁸ and the Strategy 2030 report¹⁶⁹ formally guide the way digital technologies enhance the outcomes of a project. The ADB has so far approved over 450 projects that directly or indirectly involve improving ICT infrastructure, instilling digital skills, or supporting technology-enabling policies.

Second, it is implementing digital reforms within its own organization, deploying a number of digital solutions to streamline internal operations and make internal departments more efficient. Speaking at the Digital Development Forum 2018, Mr Takehiko Nakao, ADB President, noted that the ADB must be a model of ICT-driven efficiency and productivity, emphasizing the importance of automating business processes and procedures in this regard.¹⁷⁰

Third, it is taking a hands-on approach in supporting digital ecosystems in the APAC region, especially those that promote data-driven solutions to advance the United Nations’ Sustainable Development Goals (SDGs). In early 2020, the ADB established ADB Ventures to invest in start-ups offering impactful technology solutions. With a target size of USD50 million, the fund aims to invest in early-stage start-ups and focus on companies with solutions that can address climate change, gender inequalities, agricultural challenges, and access to healthcare.¹⁷¹

Association of Southeast Asian Nations (ASEAN)

The ASEAN region – of which Brunei Darussalam, Indonesia, Malaysia, Singapore, the Philippines, Thailand, and Viet Nam are members – recognizes the importance of AI and other data-based technologies in driving economic development and sustaining economic growth.

This recognition takes the shape of multiple regional initiatives aimed at enabling technology-focused innovation and investment: the ASEAN ICT Masterplan 2016-2020,¹⁷² the Master Plan on ASEAN Connectivity 2025,¹⁷³ the ASEAN Economic Community (AEC) Blueprint 2025,¹⁷⁴ the ASEAN Smart Cities Network (ASCN),¹⁷⁵ the ASEAN Agreement on E-Commerce,¹⁷⁶ the ASEAN Framework for Personal Data Protection,¹⁷⁷ and the ASEAN Strategic Action Plan for SME Development 2016-2025.¹⁷⁸

Announced in 2019, the ASEAN Digital Integration Framework Action Plan (DIFAP) consolidates all of these initiatives by identifying six common priority areas to accelerate existing ASEAN projects and realize further digital integration.¹⁷⁹ While not a framework solely devoted to AI, it

does put data-driven technologies and their enabling policies at the heart of future integration efforts.

At the same time, several ASEAN Member States are positioning themselves as regional AI hubs, launching programs and policies that foster AI innovation and building AI ecosystems that can attract – and retain – foreign investment. According to a McKinsey report, the ASEAN region has much to gain from AI, but its current approach may be too inward-facing and industry-driven to effectively build a fully integrated regional digital economy around it.¹⁸⁰

European Commission (EC)

The European approach to AI emphasizes three key areas: collaboration across European Union (EU) members, the promotion of shared values, and the development of ethical guidelines and best practices.

Although some EU members have their own domestic AI strategies, the 25 EU members signed a Declaration of Cooperation on Artificial Intelligence in 2018 to emphasize the importance of working together to enhance research and deployment while dealing collectively with social, economic, ethical, and legal questions.¹⁸¹

At the same time, the European Commission (EC) adopted the Communication on Artificial Intelligence, a 20-page policy document that lays out its approach to AI.¹⁸² Through this, the EC aims to:

1. Increase the EU's technological and industrial capacity and AI uptake by the public and private sectors;
2. Prepare Europeans for the socioeconomic changes brought about by AI; and
3. Ensure that an appropriate ethical and legal framework is in place.

More recently, in February 2020, the EC published a White Paper aiming to foster a European ecosystem of excellence and trust in AI.¹⁸³ The White Paper highlights the urgency of a concerted regulatory framework for AI at the EU level, noting that inconsistent and unaligned approaches hinder the region's ability to remain innovative and competitive.¹⁸⁴

Group of Twenty (G20)

In June 2019, the G20 – of which Australia, Canada, the People's Republic of China, Indonesia, Japan, the Republic of Korea, Mexico, Russia, and the United States are members – adopted a set of non-binding AI Principles to ensure AI is developed in a human-centric manner.¹⁸⁵

Overall, the G20 Principles call for users and developers to ensure AI is fair and accountable, with transparent decision-making processes that respect the rule of law and implement a set of common values (privacy, equality, diversity, and internationally recognized labor rights).

The principles also urge governments to ensure no citizen is left behind as AI advances, providing a fair transition for workers through training programs and access to new job opportunities. Based on the OECD's own OECD Principles on AI, the G20 Principles underline the need for:

- Inclusive growth;

- Sustainable development and well-being;
- Human-centered values and fairness;
- Transparency and explainability;
- Robustness;
- Security and safety; and
- Accountability.

Discussions are ongoing on the launch of an International Panel on Artificial Intelligence (IPAI). Primarily championed by Canada and France, the IPAI would bring together global AI experts to facilitate and foster international collaboration and coordination on AI policy developments in line with the G20's human-centric principles.¹⁸⁶

Inter-American Development Bank (IDB)

The IDB – of which Canada, Chile, the People's Republic of China, Japan, Mexico, Peru, the Republic of Korea, and the United States are members – does not have a formalized position on AI, but it does promote and support the advancement of data-driven technologies.

It has, for example, published reports that recognize the growing importance of data analytics and algorithmic decision-making for domestic economic development and regional trade integration.¹⁸⁷ In addition, its Competitiveness, Technology, and Innovation Division provides funding, technical assistance, and knowledge products to support governments as they enable innovation through digital technologies.¹⁸⁸

The Division focuses on four main action areas:

1. Programs that provide training in science, technology, and innovation for advanced human capital;
2. Programs that strengthen scientific and technological infrastructure;
3. Programs that design public policies to promote innovation; and
4. Programs that strengthen institutional capacity of the agencies and ministries responsible for implementing these policies.

More recently, the IDB has created three entities devoted to driving both technical and technological progress at every level of its internal operations.

- The TechLab, a research body that tests and iterates new solutions for the institution's international development projects.¹⁸⁹
- The IDB Lab, an operations-driven division that mobilize financing, knowledge, and connections to catalyze innovation for economic development and inclusion.¹⁹⁰
- fAIr LAC, a regional initiative that brings together governments, universities, and the private sector to promote the fair, responsible, and ethical use of AI.¹⁹¹

Organization for Economic Cooperation and Development (OECD)

In May 2019, the OECD – of which Australia, Canada, Chile, Japan, Mexico, New Zealand, the Republic of Korea, and the United States are members – adopted the OECD Principles on AI to help member economies formulate consistent and concerted public policies and strategies on AI.¹⁹²

The responsible stewardship of trustworthy AI is guided through five main complementary, values-based principles:

- AI should benefit people and the planet by driving inclusive growth, sustainable development, and well-being.
- AI systems should be designed in a way that respects the rule of law, human rights, democratic values, and diversity, and they should include appropriate safeguards – for example, enabling human intervention where necessary – to ensure a fair and just society.
- There should be transparency and responsible disclosure around AI systems to ensure that people understand AI-based outcomes and can challenge them.
- AI systems must function in a robust, secure, and safe way throughout their life cycles and potential risks should be continually assessed and managed.
- Organizations and individuals developing, deploying, or operating AI systems should be held accountable for their proper functioning in line with the above principles.

In February 2020, the OECD launched its AI Policy Observatory to facilitate dialogue and share best practices on AI policies. A multi-disciplinary platform, the AI Policy Observatory develops metrics to measure AI research, development, and deployment, and gathers evidence to assess members' progress as they implement the organization's AI principles and recommendations.¹⁹³

United Nations (UN)

The UN – of which all but two APEC economies are members – has many ongoing programs and initiatives specifically devoted to AI. From immigration and labor unions to HIV/AIDS and food security, all UN-related bodies are undertaking some form of AI-enabled project.

In 2017, the Centre on Artificial Intelligence and Robotics was launched in the Netherlands to monitor global developments in AI and robotics. Though housed within the United Nations Interregional Crime and Justice Research Institute (UNICRI), the center provides policymakers and governmental officials with knowledge and information on all aspects of AI.¹⁹⁴

Also in 2017, a joint meeting of the United Nations General Assembly Second Committee and the Economic and Social Council (ECOSOC) was held to discuss the role digital technologies (including AI) should play in maximizing sustainable development efforts.¹⁹⁵

In 2018, the UN Convention on Certain Conventional Weapons (CCW) launched several research projects to initiate discussions related to the emergence of lethal autonomous weapons systems (LAWS).¹⁹⁶ In late 2018, the United Nations Development Program (UNDP) joined the Partnership on Artificial Intelligence, a consortium of companies, academics, and NGOs working to ensure that AI is developed in a safe, ethical, and transparent manner.¹⁹⁷

Also in 2018, the International Telecommunications Union (ITU) organized the AI for Good Global Summit, with a focus on strategies to ensure global economies develop AI in a trusted, safe, and inclusive manner and provide equitable access to its benefits.¹⁹⁸

In 2019, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) launched a two-year process to elaborate a standard-setting instrument on ethics for AI. Led by an Ad Hoc Expert Group (AHEG) of 24 specialists, the project will culminate in a UNESCO Recommendation centered on actionable principles to make AI socially useful and responsible.¹⁹⁹

Also in 2019, the ITU published the United Nations Activities on Artificial Intelligence (AI) report, a

detailed compendium gathering all AI-related activities and innovations launched by the 36 UN-affiliated organizations.²⁰⁰

World Bank (WB)

The World Bank – of which all but two APEC economies are members – has many ongoing projects and programs related to AI. Like the ADB, it leverages AI to streamline and improve its own internal processes, and like the UN, it promotes the use of AI in the projects it coordinates and funds.

Three main initiatives stand out:

Development Impact Evaluation (DIME)²⁰¹:

Statistical tools such as the World Development Indicators database are the backbone of the development projects led by the World Bank. There is the collection and normalization of all manner of data related to social and economic development, as well as making datasets accessible and usable to member economies. The DIME system is a major data analytics tool that leverages machine learning to help member economies model the impact of specific policies on selected aspects of economic development. Using a number of pre-determined variables, DIME makes it possible to ‘map’ the likely impact of a given policy instrument on a given policy issue, and make any necessary adjustments based on desired outcome.

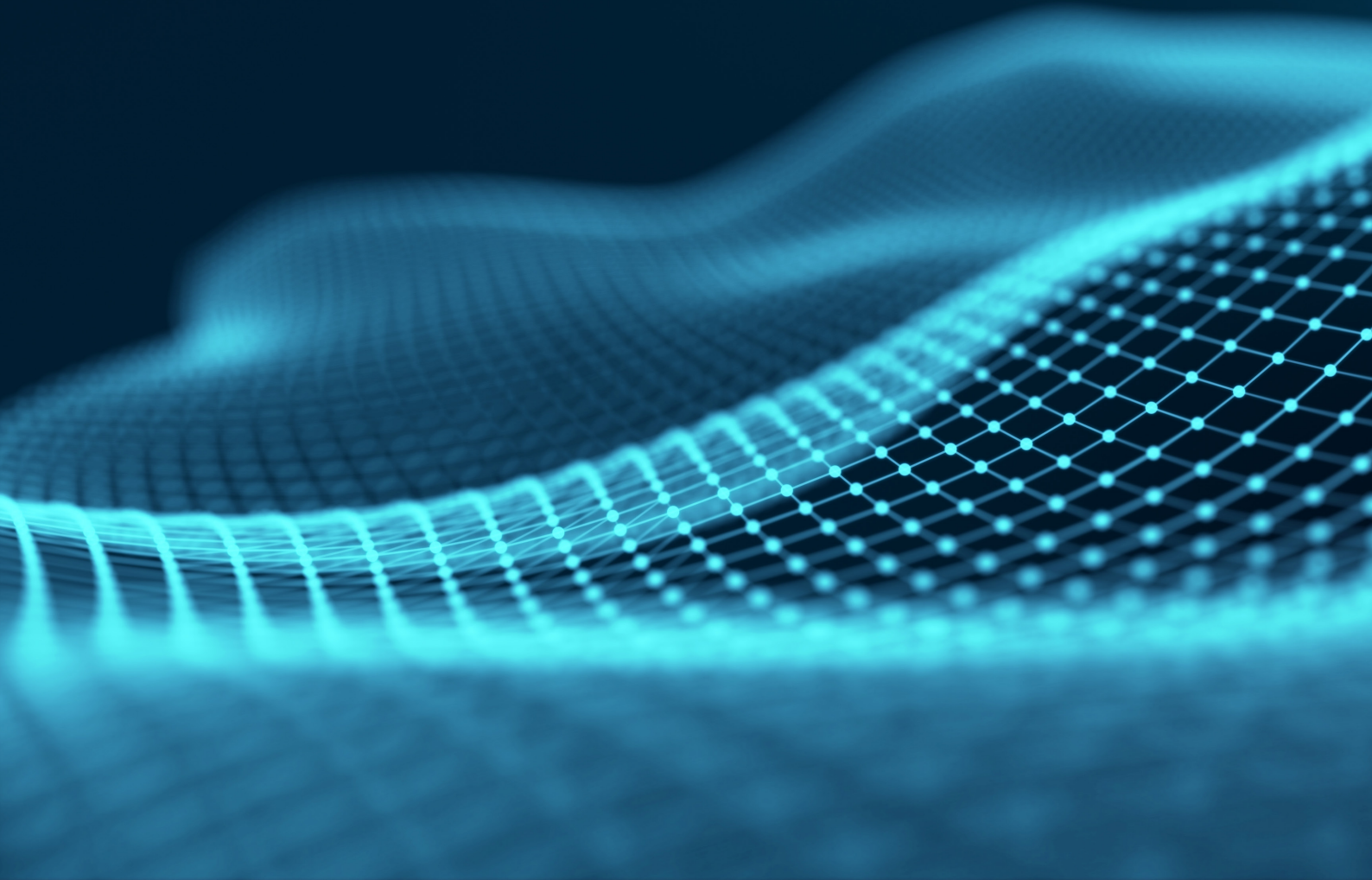
Technology and Innovation Lab:

Stemming from an informal working group on blockchain, the Technology and Innovation Lab is now a fully staffed World Bank unit devoted to researching and developing technological solutions to solve socio-economic problems.²⁰² Comprising two separate labs – one for blockchain and one for AI – the unit works with internal operational teams within the World Bank to test the efficacy and relevance of emerging technologies for economic development applications (machine learning, neural networks, natural language processing, assistive technologies, data modelling/analytics, and advanced data management).

The Disruptive Technology for Development (DT4D) Challenge and Fund:

The World Bank’s Finance, Competitiveness, and Innovation (FCI) practice is behind the launch of the Disruptive Technologies for Development (DT4D) Challenge, an annual competition aiming to identify and pilot scalable disruptive technology solutions in World Bank operations – with a special focus on solutions that can solve problems where more traditional tools have not worked.²⁰³ Meanwhile, the Disruptive Technologies for Development Fund was launched in partnership with Credit Suisse to identify and pilot the use of digital technologies to foster sustainable, tech-enabled growth in developing economies. Funded by donor contributions, the idea is to allow donors to leverage the World Bank’s global expertise and portfolio of operations to maximize their philanthropic impact.²⁰⁴

REFERENCES



- 1 United Nations (UN), <http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2006/MDGReport2006.pdf>
- 2 World Economic Forum (WEF), www.weforum.org/agenda/2016/01/a-recap-of-davos-2016
- 3 Pacific Economic Cooperation Council (PECC), www.pecc.org/resources/publications/regional-cooperation-1/2608-pecc-apec-2020-vision
- 4 APEC, www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Human-Resources-Development/Framework
- 5 APEC, <https://aimp2.apec.org/sites/PDB/Lists/Concept%20Notes/DispForm.aspx?ID=2017>
- 6 G20 Insights, www.g20-insights.org/wp-content/uploads/2019/07/G20-Japan-AI-Principles.pdf
- 7 OECD, www.oecd.org/going-digital/ai
- 8 State Council, <https://flia.org/wp-content/uploads/2017/07/A-New-Generation-of-Artificial-Intelligence-Development-Plan-1.pdf>
- 9 Cabinet Office, www8.cao.go.jp/cstp/english/humancentricai.pdf
- 10 Wizeline, <http://go.wizeline.com/rs/571-SRN-279/images/Towards-an-AI-strategy-in-Mexico.pdf>
- 11 National Research Foundation (NRF), www.nrf.gov.sg/docs/default-source/modules/pressrelease/201705031442082191-press-release-ai.pdf
- 12 Executive Yuan, <https://english.ey.gov.tw/News3/9E5540D592A5FECD/1dec0902-e02a-49c6-870d-e77208481667>
- 13 White House, www.whitehouse.gov/articles/accelerating-americas-leadership-in-artificial-intelligence
- 14 Government of Chile, www.gob.cl/en/news/government-announces-artificial-intelligence-plan-be-developed-science-ministry
- 15 Tech Wire Asia, <https://techwireasia.com/2020/08/indonesia-sets-sights-on-ai-with-new-national-strategy>
- 16 The Edge Markets, www.theedgemarkets.com/article/alibaba-and-malaysia-reaffirm-partnership
- 17 Office of the Prime Minister, www.nesdb.gov.th/nesdb_en/ewt_w3c/ewt_dl_link.php?nid=4345
- 18 Forbes, www.forbes.com/sites/forbestechcouncil/2018/02/16/can-ai-be-trusted-with-life-and-death-decisions/#5e361e845951
- 19 European Commission (EC), <https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai>
- 20 OECD, www.oecd.org/going-digital/ai/principles
- 21 Ministry of Trade and Industry (MTI), www.mti.gov.sg/Improving-Trade/Free-Trade-Agreements/Digital-Economy-Agreements/The-Digital-Economy-Partnership-Agreement
- 22 Department of Industry, Science, Energy, and Resources, www.industry.gov.au/data-and-publications/building-australias-artificial-intelligence-capability/ai-ethics-framework
- 23 Department of Industry, Science, Energy, and Resources, www.industry.gov.au/data-and-publications/building-australias-artificial-intelligence-capability/ai-ethics-framework/ai-ethics-principles
- 24 Standards Australia, www.standards.org.au/news/standards-australia-sets-priorities-for-artificial-intelligence
- 25 Center for International Governance Innovation (CIGI), www.cigionline.org/articles/canadian-government-calls-human-centric-approach-ai
- 26 IMDA, www.imda.gov.sg/about/newsroom/media-releases/2018/inaugural-meeting-of-the-advisory-council-on-the-ethical-use-of-artificial-intelligence-and-data
- 27 PDPC, www.pdpc.gov.sg/Resources/Discussion-Paper-on-AI-and-Personal-Data
- 28 MAS, www.mas.gov.sg/News-and-Publications/Media-Releases/2018/MAS-introduces-new-FEAT-Principles-to-promote-responsible-use-of-AI-and-data-analytics.aspx
- 29 OECD, <https://stip.oecd.org/stip/policy-initiatives/2017%2Fdata%2FpolicyInitiatives%2F16993>
- 30 Ministry of Science and ICT (MSIT), https://english.msit.go.kr/cms/english/pl/policies2/_icsFiles/afieldfile/2017/07/20/Master%20Plan%20for%20the%20intelligent%20information%20society.pdf
- 31 It is perhaps also worth noting that all 21 APEC economies are participating in at least one regional or multilateral agreement either on AI or encompassing some specific aspect of AI, demonstrating a willingness to contribute to and participate in regional alignment to boost coordination and development opportunities. This includes the OECD framework described above, as well as AI discussions taking place within the Asian Development Bank (ADB), the Association of Southeast Asian Nations (ASEAN), the Group of Twenty (G20), the Inter-American Development Bank (IDB), the United Nations, and the World Bank (see Annex III for an overview of these regional AI frameworks).
- 32 Embassy of Switzerland in Tokyo, www.stofficetokyo.ch/sites/default/files/2018-11/SmartAgricultureJapan2018.pdf
- 33 CW, www.cw.com.tw/amp/article/5099639
- 34 Visa, <https://developer.visa.com/capabilities/visa-travel-predict>
- 35 Association for Computing Machinery (ACM), <https://dl.acm.org/doi/10.1145/2843948>
- 36 Christie's, www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx
- 37 Russia Business Today, <https://russiabusinesstoday.com/technology/foreign-investors-to-help-russias-ai-development-with-2bn>
- 38 GAN algorithms are a class of machine learning frameworks that generate a wide range of synthetic instances of data that can pass for real, including hand-written text, still images, moving pictures, and soundwaves. They can be used to create original prose, images, videos, and voices that are difficult to recognize as 'artificial', but they can also be used to generate derivative content that imitates or deceives (GANs are behind the 'Deepfake' phenomenon). See: Interesting Engineering, <https://interestingengineering.com/generative-adversarial-networks-the-tech-behind-deepfake-and-faceapp>
- 39 The Verge, www.theverge.com/2019/3/6/18222203/video-game-ai-future-procedural-generation-deep-learning
- 40 Computer Vision Foundation (CVF), http://openaccess.thecvf.com/content_cvpr_2018_workshops/papers/w29/Barsoum_HP-GAN_Probabilistic_3D_CVPR_2018_paper.pdf
- 41 VFX Wire, www.vfxwire.com/deepfake-and-what-it-could-mean-for-the-film-industry

42 Synced Review, <https://syncedreview.com/2019/08/29/ai-creates-fashion-models-with-custom-outfits-and-poses>

43 Electronic Navigation Research Institute (ENRI), <https://hal-enac.archives-ouvertes.fr/hal-02267170/document>

44 Reuters, www.reuters.com/article/us-chile-unemployment/chile-jobless-rate-hits-9-during-pandemic-highest-in-decade-idUSKBN2351YD

45 Genoma is the algorithm that detects candidates' personality traits and cognitive skills based on their actions and reactions when playing purpose-built neuroscience-based games. As job candidates advance in the game, the AI system extracts and analyzes thousands of inter-linked variables on their behavior. The AI then cross-references these variables with whichever 'ideal' traits the recruiting company has defined for a given role, and assesses their potential ability to both perform in the role and mesh with a team of collaborators.

46 World Economic Forum (WEF), www.weforum.org/agenda/2020/05/coronavirus-unemployment-jobs-work-impact-g7-pandemic

47 National Geographic, www.nationalgeographic.com/history/archaeology/nasca-lines

48 Ministerio de Cultura, www.gob.pe/institucion/cultura/noticias/47717-ministerio-de-cultura-trabaja-en-la-proteccion-y-preservacion-de-lineas-y-geoglifos-de-nasca

49 Deutsche Welle, www.dw.com/es/per%C3%BA-las-l%C3%ADneas-de-nazca-un-patrimonio-en-peligro/a-42386044

50 TV Peru, www.tvperu.gob.pe/noticias/regionales/lineas-de-nazca-ministerio-de-cultura-y-pnp-destruyeron-120-viviendas-de-invasores

51 Yamagata University, www.yamagata-u.ac.jp/en/information/info/20191115_01

52 Andina, <https://andina.pe/agencia/noticia-lineas-nasca-fortaleceran-vigilancia-incluso-noche-para-evitar-nuevos-danos-697692.aspx>

53 Downfall Air Receiver Technology (DART)

54 Oil & Gas Portal, www.oil-gasportal.com/innovation-rd/airborne-seismic/?print=pdf

55 Duffy S.W. et al., www.healio.com/hematology-oncology/breast-cancer/news/online/%7Bf2c4a1c6-fd43-4326-a282-d31a64e9f774%7D/mammography-screening-substantially-decreases-risk-for-fatal-breast-cancer

56 World Health Organization (WHO), www.who.int/cancer/prevention/diagnosis-screening/breast-cancer/en

57 Ministry of Health, www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/breast-cancer

58 World Health Organization (WHO), www.who.int/cancer/publications/mammography_screening/en

59 American Cancer Society, www.cancer.org/cancer/breast-cancer/screening-tests-and-early-detection/mammograms/limitations-of-mammograms.html

60 NLP is the branch of AI that focuses on helping machines read, decipher, understand, and make sense of human communication.

61 Wikipedia, <https://en.wikipedia.org/wiki/Aphasia>

62 National Institute of Health (NIH), <https://rarediseases.info.nih.gov/diseases/6919/locked-in-syndrome>

63 The Guardian, www.theguardian.com/world/2012/aug/07/locked-in-syndrome-richard-marsh

64 Jose C Navarro et al., <https://pubmed.ncbi.nlm.nih.gov/24844610/>

65 World Life Expectancy, www.worldlifeexpectancy.com/philippines-stroke

66 World Health Organization (WHO), www.who.int/nmh/countries/phl_en.pdf

67 Jay Patrick M. Nieves et al., www.researchgate.net/publication/331749663_Characterization_of_EEG_Signal_Patterns_During_Visual_Imageries_of_Basic_Structures_for_the_Development_of_Brain-Computer_Typing_Interface_for_Locked-In_Syndrome_Patients

68 The Guardian, www.theguardian.com/world/2012/aug/07/locked-in-syndrome-richard-marsh

69 Business Insider, <https://markets.businessinsider.com/news/stocks/aeromexico-taps-yalochat-com-and-iv-ai-to-build-first-advanced-ai-customer-service-chatbot-1001928299>

70 Air Canada, www.aircanada.com/ca/en/aco/home/about/media/media-features/artificial-intelligence-labs.html

71 DSTA, www.dsta.gov.sg/docs/default-source/news-releases-documents/dsta-and-rolls-royce-collaborate-on-digital-technology-news-release.pdf?sfvrsn=2

72 SCMP, www.scmp.com/lifestyle/travel-leisure/article/3047007/what-smart-airports-future-will-be-air-taxis-5g-sensor

73 International Air Transport Association (IATA), www.iata.org/en/pressroom/pr/2020-04-24-01

74 World Bank, www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii

75 Personal Data Protection Commission (PDPC), www.pdpc.gov.sg/Help-and-Resources/2020/01/Model-AI-Governance-Framework

76 SCMP, www.scmp.com/tech/science-research/article/2145568/can-trumps-ai-summit-match-chinas-ambitious-strategic-plan

77 Asian Scientist, www.asianscientist.com/2018/03/topnews/southeast-asia-ai-research-clarivate

78 Open Gov Asia, www.opengovasia.com/south-korea-to-invest-2-2-trillion-won-in-bid-to-seize-the-lead-in-ai-technology-by-2022

79 Tech in Asia, www.techinasia.com/indonesia-ai-digital-disruption

80 Enterprise IT News, www.enterpriseitnews.com.my/artificial-intelligence-in-malaysia-challenged

81 Thailand Board of Investment, www.prnewswire.com/news-releases/thailand-promotes-ai-robotics-technology-to-spur-industry-4-0-readiness-300854969.html

- 82 Contxto, www.contxto.com/en/peru/peruvian-subtitles-glasses-help-hearing-loss/
- 83 La República, <https://larepublica.pe/sociedad/2020/01/19/mit-ingeniero-peruano-leoncio-human-peredo-es-premiado-por-su-proyecto-para-personas-son-discapacidad-auditiva-atmp>
- 84 World Health Organization (WHO), www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss
- 85 Wired, www.wired.com/story/covid-19-will-accelerate-ai-health-care-revolution
- 86 Ministry of Foreign Affairs and Trade (MFAT), www.mfat.govt.nz/en/trade/free-trade-agreements/free-trade-agreements-concluded-but-not-in-force/digital-economy-partnership-agreement/depa-text-and-resources
- 87 McKinsey, www.mckinsey.com/~media/mckinsey/featured%20insights/Future%20of%20Organizations/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017.ashx
- 88 IoT News, www.iottechnews.com/news/2019/aug/21/australia-deploy-ai-drones-crocodiles-swimmers
- 89 Mining Technology, www.mining-technology.com/news/newcrest-mining-partners-tcs-increase-use-automation-ai
- 90 Speaking at the launch of the APEC Framework on Human Resources Development in the Digital Age, Dr Alan Bollard, then-Executive Director of the APEC Secretariat, noted that "There will be loss of jobs to automation. (...) But we also know many new jobs will arise in the digital economy [...]. It is very difficult to forecast (...) where jobs will be in the years ahead, but we believe that they will be there. APEC's policy approach is about equipping people for the jobs of the future and building social protection for those who have difficulty adjusting." See APEC, www.apec.org/Press/News-Releases/2017/0516_HRD
- 91 Techwire Asia, <https://techwireasia.com/2020/05/mastercard-on-how-covid-19-is-accelerating-contactless-payments-in-asia>
- 92 Ibid.
- 93 World Trade Organization (WTO), www.wto.org/english/tratop_e/covid19_e/ecommerce_report_e.pdf
- 94 Statista, www.statista.com/statistics/265767/number-of-cashless-transactions-worldwide-by-region
- 95 Mastercard, <https://globalrisk.mastercard.com/wp-content/uploads/2018/10/SafetyNetExternalPresentationGLOBALSep18.pdf>
- 96 Forbes, www.forbes.com/sites/peterhigh/2019/04/08/mastercards-ed-mclaughlin-wins-forbes-cio-innovation-award-based-with-an-ai-safetynet/#1a58175e5c81
- 97 CIO.com, www.cio.com/article/3322927/3-ways-mastercard-uses-ai-to-fight-fraud.html
- 98 Asia-Pacific Economic Cooperation (APEC), <https://apec.org/Publications/2020/03/Guidebook-on-SME-Embracing-Digital-Transformation>
- 99 Organization for Economic Cooperation and Development (OECD), www.oecd.org/going-digital/framework
- 100 Gartner, www.gartner.com/en/human-resources/trends/raconteur-digitalization-article
- 101 World Economic Forum (WEF), www.weforum.org/agenda/2020/05/coronavirus-unemployment-jobs-work-impact-g7-pandemic
- 102 Contxto, www.contxto.com/en/chile/genomawork-ai-gaming-predict-job-potential
- 103 Ibid.
- 104 Diario Estrategia, www.diarioestrategia.cl/texto-diario/mostrar/1737301/chilenos-crean-sistema-contratacion-traves-inteligencia-artificial
- 105 CGTN, www.cgtn.com/special/Battling-the-novel-coronavirus-What-we-know-so-far-.html
- 106 Fierce Biotech, www.fiercebiotech.com/medtech/current-covid-19-antibody-tests-aren-t-accurate-enough-for-mass-screening-say-oxford
- 107 Verdict, www.medicaldevice-network.com/features/types-of-covid-19-test-antibody-pcr-antigen
- 108 Huawei, www.huaweicloud.com/intl/en-us/news/20200410203805892.html
- 109 Twitter, <https://twitter.com/ottosonnenh/status/1241748983409770496>
- 110 Food and Agriculture Organization (FAO), www.fao.org/3/a-i6583e.pdf
- 111 Embassy of Switzerland in Tokyo, www.stofficetokyo.ch/sites/default/files/2018-11/SmartAgricultureJapan2018.pdf
- 112 Straits Times, www.straitstimes.com/singapore/health/coronavirus-fairprice-chief-urges-calm-amid-panic-buying-of-groceries-singapore
- 113 Business Insider, www.businessinsider.sg/coronavirus-panic-buying-france-japan-netherlands-poland-2020-3?r=US&IR=T
- 114 McKinsey, www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/winning-the-30-trillion-decathlon-going-for-gold-in-emerging-markets
- 115 McKinsey, www.mckinsey.com/featured-insights/americas/latin-americas-missing-middle-of-midsize-firms-and-middle-class-spending-power
- 116 Salesforce, www.salesforce.com/research/customer-expectations
- 117 INEGI, www.inegi.org.mx/programas/dutih/2018/default.html#Tabulados
- 118 Yalochat, www.yalochat.com/blog/a-service-designed-for-you-using-messaging-to-personalize-user-experience
- 119 AI Forum, <https://aiforum.org.nz/towards-our-intelligent-future>
- 120 AI Forum, <https://aiforum.org.nz/reports/artificial-intelligence-for-health-in-new-zealand>
- 121 World Health Organization (WHO), www.who.int/cancer/prevention/diagnosis-screening/breast-cancer/en

- 122 Duffy S.W. et al., www.healio.com/hematology-oncology/breast-cancer/news/online/%7Bf2c4a1c6-fd43-4326-a282-d31a64e9f774%7D/mammography-screening-substantially-decreases-risk-for-fatal-breast-cancer
- 123 World Health Organization (WHO), www.who.int/cancer/publications/mammography_screening/en
- 124 American Cancer Society, www.cancer.org/cancer/breast-cancer/screening-tests-and-early-detection/mammograms/limitations-of-mammograms.html
- 125 Volpara Solutions, <https://volparasolutions.com/our-products/volparadensity>
- 126 United Nations (UN), www.un.org/en/sections/issues-depth/population/index.html
- 127 International Energy Agency (IEA), www.iea.org/reports/world-energy-outlook-2019#
- 128 GeoExPro, www.geoexpro.com/articles/2018/04/the-future-of-onshore-seismic
- 129 Total, www.ep.total.com/en/innovations/research-development/metis-integrated-geophysical-acquisition-system-quality-real-time
- 130 Ibid.
- 131 Vintage News, www.thevintagenews.com/2019/06/24/nazca-lines-mystery
- 132 National Geographic, www.nationalgeographic.com/history/archaeology/nasca-lines
- 133 Express, www.express.co.uk/news/weird/872041/aliens-Nazca-Lines-tomb-UFO-peru
- 134 Yamagata University, www.yamagata-u.ac.jp/en/information/info/20191115_01
- 135 The Verge, www.theverge.com/2019/11/19/20970578/nazca-lines-ai-machine-learning-143-new-geoglyphs-ibm-japan-yamagata-university
- 136 Science News, www.sciencenews.org/article/ai-found-hidden-nazca-line-peru-showing-humanoid-figure
- 137 Yamagata University, www.yamagata-u.ac.jp/en/information/info/20191115_01
- 138 Wikipedia, <https://en.wikipedia.org/wiki/Aphasia>
- 139 National Institute of Health (NIH), <https://rarediseases.info.nih.gov/diseases/6919/locked-in-syndrome>
- 140 The Guardian, www.theguardian.com/world/2012/aug/07/locked-in-syndrome-richard-marsh
- 141 Jose C Navarro et al., <https://pubmed.ncbi.nlm.nih.gov/24844610/>
- 142 World Life Expectancy, www.worldlifeexpectancy.com/philippines-stroke
- 143 World Health Organization (WHO), www.who.int/nmh/countries/phl_en.pdf
- 144 IEEE, <https://ieeexplore.ieee.org/document/8666333>
- 145 IEEE, <https://ieeexplore.ieee.org/document/9068713>
- 146 Jay Patrick M. Nieves et al., www.researchgate.net/publication/331749663
- 147 World Economic Forum (WEF), www.weforum.org/agenda/2018/12/a-new-prosthetic-arm-takes-the-place-of-a-phantom-limb
- 148 Health IT Analytics, <https://healthitanalytics.com/news/artificial-intelligence-models-identify-alzheimers-cognitive-decline>
- 149 The Verge, www.theverge.com/2019/7/11/20690078/ai-poker-pluribus-facebook-cmu-texas-hold-em-six-player-no-limit
- 150 Deep Mind, <https://deepmind.com/research/case-studies/alphago-the-story-so-far>
- 151 IBM, www.ibm.com/watson/services/tone-analyzer
- 152 Wrnch, <https://wrnch.ai>
- 153 Forbes, www.forbes.com/sites/bernardmarr/2019/03/29/artificial-intelligence-can-now-write-amazing-content-what-does-that-mean-for-humans/#6a53578850ab
- 154 The Verge, www.theverge.com/2018/8/31/17777008/artificial-intelligence-taryn-southern-amper-music
- 155 RDIF, https://rdif.ru/Eng_fullNews/4115
- 156 Christie's, www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx
- 157 Ajel, <https://ajelen.com/two-saudi-women-participate-in-digital-art-exhibition-at-st-petersburg>
- 158 RDIF, https://rdif.ru/Eng_fullNews/4115
- 159 Vimeo, <https://vimeo.com/263465997>
- 160 Servion, <https://servion.com/blog/what-emerging-technologies-future-customer-experience>
- 161 Finance Latvia, www.financelatvia.eu/wp-content/uploads/2018/01/Nina-the-future-of-customer-service-automation_Hans-Lindholt.pdf
- 162 Monetary Authority of Singapore (MAS), www.mas.gov.sg/~media/MAS/News%20and%20Publications/Monographs%20and%20Information%20Papers/FEAT%20Principles%20Final.pdf
- 163 Personal Data Protection Commission (PDPC), www.pdpc.gov.sg/~media/Files/PDPC/PDF-Files/Resource-for-Organisation/AI/SGAIGovUseCases.pdf
- 164 MOMO, http://en.fmt.com.tw/index.php?option=com_content&view=article&id=629&Itemid=41
- 165 CW, www.cw.com.tw/amp/article/5099639
- 166 Google, <https://cloud.google.com/customers/translatelive>
- 167 Google, <https://cloud.google.com/customers/descript>
- 168 Asian Development Bank (ADB), <https://events.development.asia/system/files/materials/2019/03/201903-ADB-s-digital-technology-development-unit.pdf>
- 169 Asian Development Bank (ADB), www.adb.org/about/strategy-2030-operational-priorities
- 170 Asian Development Bank (ADB), www.adb.org/news/speeches/opening-digital-development-forum-2018-takehiko-nakao

171 Modern Diplomacy, <https://moderndiplomacy.eu/2020/02/01/adb-unveils-venture-platform-to-invest-in-impact-technology-startups>

172 ASEAN, www.asean.org/storage/images/2015/November/ICT/15b%20--%20AIM%202020_Publication_Final.pdf

173 ASEAN, <https://asean.org/wp-content/uploads/2016/09/Master-Plan-on-ASEAN-Connectivity-20251.pdf>

174 ASEAN, www.asean.org/storage/2016/03/AECBP_2025r_FINAL.pdf

175 ASEAN, www.asean2018.sg/Newsroom/ASCN

176 Ministry of Trade and Industry (MTI), www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2018/11/17th-AECC/Annex-A-Factsheet-on-ASEAN-Agreement-on-e-Commerce.pdf

177 ASEAN, <https://asean.org/storage/2012/05/10-ASEAN-Framework-on-PDP.pdf>

178 ASEAN, https://asean.org/?static_post=asean-strategic-action-plan-for-sme-development-2016-2025-2

179 ASEAN, https://asean.org/storage/2018/02/AECC18-ASEAN-DIFAP_Endorsed.pdf

180 McKinsey, www.mckinsey.com/~/_/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20ESE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.pdf

181 European Commission, <https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-artificial-intelligence>

182 European Commission, <https://ec.europa.eu/digital-single-market/en/news/communication-artificial-intelligence-europe>

183 European Commission, https://ec.europa.eu/info/files/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en

184 Ibid.

185 G20, www.mofa.go.jp/files/000486596.pdf

186 Government of Canada, www.canada.ca/en/innovation-science-economic-development/news/2019/05/declaration-of-the-international-panel-on-artificial-intelligence.html

187 Inter-American Development Bank (IDB), <https://publications.iadb.org/en/integration-and-trade-journal-volume-22-no-44-july-2018-planet-algorithm-artificial-intelligence>

188 Inter-American Development Bank (IDB), www.iadb.org/en/topics/competitiveness-technology-and-innovation

189 Forbes, www.forbes.com/sites/peterhigh/2019/04/02/the-inter-american-development-bank-innovation-lab-focuses-on-block-chain-and-quantum-computing/#7948644ada73

190 IDB Lab, <https://bidlab.org/en/about>

191 fAIR LAC, www.iadb.org/en/fairlac

192 OECD, <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449>

193 OECD, <https://oecd.ai/about>

194 United Nations (UN), www.unicri.it/topics/ai_robotics

195 United Nations (UN), www.un.org/sustainabledevelopment/blog/2017/10/looking-to-future-un-to-consider-how-artificial-intelligence-could-help-achieve-economic-growth-and-reduce-inequalities

196 United Nations (UN), <https://undir.org/files/publications/pdfs/the-weaponization-of-increasingly-autonomous-technologies-artificial-intelligence-en-700.pdf>

197 United Nations (UN), www.undp.org/content/undp/en/home/news-centre/news/2018/undp-joins-tech-giants-in-partnership-on-ai.html

198 United Nations (UN), <https://aiforgood.itu.int>

199 United Nations (UN), <https://en.unesco.org/artificial-intelligence/ethics>

200 United Nations (UN), www.itu.int/pub/S-GEN-UNACT-2019-1

201 World Bank, www.worldbank.org/en/research/dime/overview#2

202 MIT Press Journals, www.mitpressjournals.org/doi/pdf/10.1162/inov_a_00264

203 World Bank, <https://world-bank-group.forms.fm/dt4d-challenge/forms/6059>

204 World Bank, www.worldbank.org/en/news/press-release/2018/05/01/world-bank-group-and-credit-suisse-launch-disruptive-technologies-for-development-fund

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