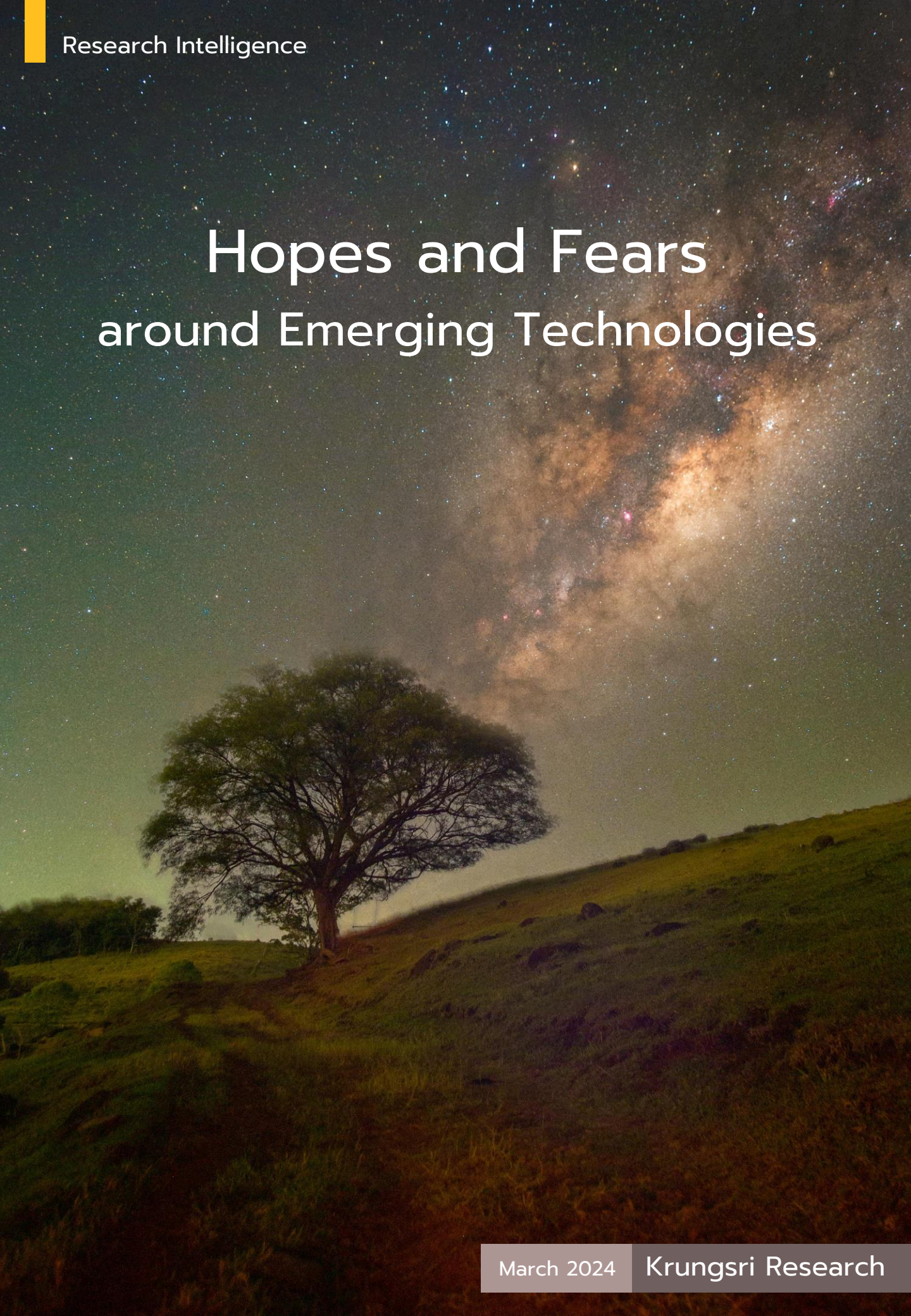
Research Intelligence

Hopes and Fears
around Emerging Technologies



March 2024 Krungsri Research

krungsri Research

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Contents

Introduction	3
What is emerging technology?	4
Applications of emerging technology	7
Krungsri Research's survey results on hopes and fears around technology	9
Krungsri Research view	17
References	18

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Introduction

'Emerging technology' covers a wide range of innovations that can generate significant impacts on society and the economy, although at present, these are still at an early stage of implementation and so retain enormous potential for future development. Undeniably, **the numerous benefits of emerging technologies have sparked hopes for development in various dimensions that can lead to an improved quality of life for humans. However, viewed from another perspective, the lack of knowledge, understanding, and technological skills may give rise to fears and concerns that these technologies may pose threats to humanity**, and these worries have been boosted by a genuine lack of certainty over the likely long-term impacts. Against this backdrop, the process of introducing and exploiting these emerging technologies needs to be managed carefully, and attendant risks need to be monitored and minimized. This is an area where the government has an important role to play, especially with regard to designing an appropriate regulatory environment and then providing oversight of these technologies as they are deployed in consumers' day-to-day lives and in organizational and enterprise contexts. Nevertheless, successfully managing these challenges will make a major contribution towards driving the future development of the country.

In light of this and to better understand the current situation, Krungsri Research has surveyed members of the public on their hopes and fears around emerging technologies. In addition, research conducted abroad on these topics has been reviewed, and the findings from both the survey and literature review have been used to guide relevant parties to effectively plan appropriate responses to the anticipated positive and negative changes resulting from the swift transformation of the technological landscape.

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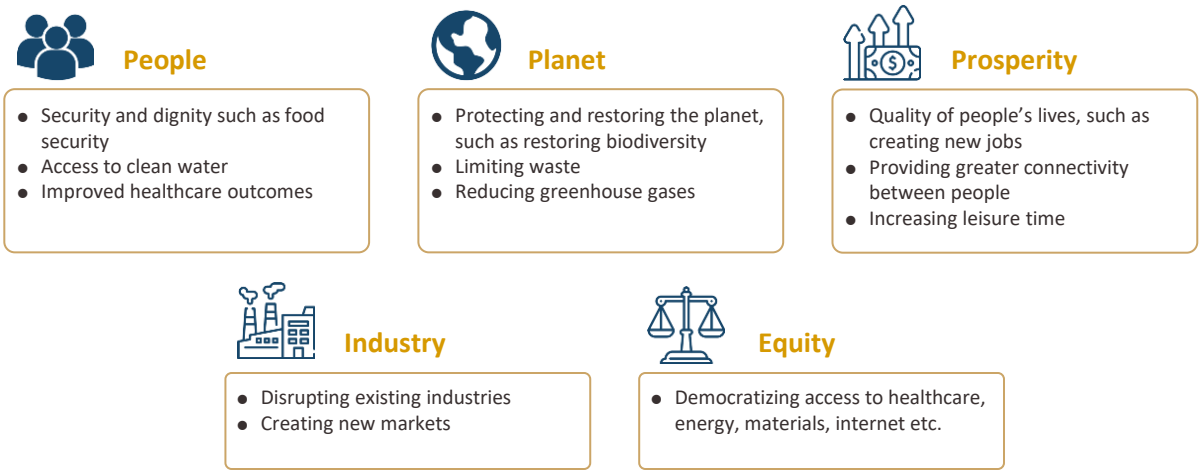
What is emerging technology?

Although there is no fully exhaustive and agreed-upon definition of exactly what 'emerging technologies' are, research in this area[1/] has settled on an understanding of the term that considers a range of factors extending over development, impacts, and applications. Key points encompassed by these definitions are:

1. **Novelty:** An emerging technology may still be at the initial stages of exploration and development. Alternatively, it may have reached the stage when applications have begun to emerge, but if so, uptake of these will not yet be widespread, though the speed of development and the adoption rate will typically be high.
2. **Wide-ranging impacts:** Emerging technology can be expected to have wide-reaching impacts on the economy, society, and the environment. Research by the World Economic Forum classifies these impacts under the five headings of: people (safety and facilitating day-to-day life), the planet (ensuring planetary protection), prosperity (accelerating development and improving livelihoods), industry (increasing new opportunities for industry, for example by developing new markets for products and services), and equity (ensuring that members of society enjoy equal opportunities).
3. **Long-term impacts:** Emerging technology has the potential to precipitate large-scale transformations of society, and to bring about fundamental long-term changes in how individuals live and how industry is organized.

Figure 1

Wide-ranging Impacts of Emerging Technologies



Source: World Economic Forum, Krungsri Research

1/ For example, S. Cozzens et al. (2010), Rotolo et al. (2015), Stanford University (2023), World Economic Forum (2023)

In brief, emerging technologies typically attract a significant level of interest or are beginning to take shape in publicly visible applications. These are in addition viewed as having the potential to generate both positive and negative impacts on society and the economy in the coming period, though these impacts may also be long-lasting. Examples of some of the new technologies that as of 2024 are generating the most interest and discussion in world-leading organizations[2/] are given below.

- **Artificial Intelligence (AI)**

AI burst into the public imagination in 2023 with the release of advanced generative AI models that appeared to have human-like levels of creativity,[3/] and this undoubtedly marked a major step forward in the evolution of machine intelligence. These AI models have already begun to be used in an enormous range of applications, and as development continues, these are finding a role even in matters of life and death, for example in diagnosing medical conditions and assisting with the research and development of new treatments.

- **Flexible batteries**

Flexible batteries will be at the heart of innovations such as wearable technology, new kinds of medical devices, smart clothing, and foldable or bendable computers and smart phones. Among the emerging technologies, the World Economic Forum (2023) sees flexible batteries having their maximum impact within the next 3-5 years.[4/]

Figure 2

Flexible Batteries



Source: Tycorun

- **Medical technology**

Innovations from emerging technologies may also be used to improve physical and mental health outcomes. For example, metaverse applications may be used in mental health interventions, and flexible neural electronics may be used to assist with diagnoses and in the development of brain-machine interfaces that allow computers to directly respond to human intentions and desires.

2/ For example, World Economic Forum (https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf), PwC (https://www.pwc.com/us/en/tech-effect/emerging-tech/essential-eight-technologies.html), the United Nations (https://libraryresources.unog.ch/c.php?g=673842&p=4792828), and Stanford University (https://setr.stanford.edu/sites/default/files/2023-11/SETR_web_231120.pdf)

3/ For more details, please see: Generative AI: A World-Changing Technology

4/ https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf

- **Sustainable technology**

New technologies have the potential to help societies reach their net zero targets. This will be through routes such as the use of biomass to create sustainable aviation fuel that cuts carbon dioxide emissions from the airline industry, the development of sustainable computing and the transition of data centers to net zero, and the use of Carbon Capture, Utilization, and Storage (CCUS) technologies to drawdown atmospheric carbon and then to use this in commercial applications or to store this in secure subsurface facilities.

- **Blockchains**

Blockchains deploy Distributed Ledger Technologies (DLT) to store data and process transactions in a way that is both transparent and secure. Blockchain technologies have been used in a wide range of industries where intermediaries play a prominent role processing and verifying data, including in finance, public health, and supply chain management.

- **Space technology**

The ability to travel into space and to use advanced technologies to better investigate the universe has provided benefits for all of humanity, including improved knowledge of how stars and galaxies are born and what kinds of extraterrestrial resources might be available. In addition, computer-enhanced digital signal processing technologies pioneered by NASA to survey the surface of the moon are now used in advanced medical and diagnostic imaging technologies, such as computerized tomography (or CT) scans.

- **Defense technology**

Cutting edge technologies such as AI and robotics are being used to enhance the capabilities of weapons systems, and militaries around the world are now able to conduct operations using smart weapons (e.g., military robots) that have varying degrees of autonomy. In addition, technological progress is driving the emergence of new types of warfare, one example of which is cyberwar, or the use of digital technologies to penetrate or disable an opponent's IT infrastructure.

These seven examples show that 'emerging technology' is a broad term that is not linked to any particular innovation or area, and indeed, the phrase will surely be used to describe developments that fall into areas outside those of the examples given above.

Applications of emerging technology

Emerging technologies clearly have the potential to be used in a huge number of beneficial ways. In the area of **healthcare**, progress with medical technology continues apace and in particular, this has helped to make diagnoses more accurate and better informed. For example, electronic health records (EHR)[5/] gather together detailed and comprehensive patient data, which then allows doctors to make faster, more accurate diagnoses and treatment recommendations. Another example of recent technological innovation is the multi-angle rear-viewing endoscopic tool (MARVEL).[6/] Using this reduces the risk of injury during surgery, thereby cutting the chance that patients will develop secondary infections and improving the speed of their recovery. Computerized **hospital management systems** are also now able to physically track and locate medications and equipment with a great deal of accuracy, and this then helps administrators manage medicines, equipment, and overall budgets much more effectively. Beyond this, tele-consulting technology has made considerable strides, again improving efficiencies within the medical industry.

Figure 3

TytoCare Basic Healthcare and Tele-Medicine Monitoring Equipment



Source: TytoCare

AI technologies will also become widespread in the healthcare sector, and research by McKinsey and Harvard University published in January 2023 estimates that within 5 years, use of AI will have cut US spending on healthcare by 5-10%, or by around USD 200-360 billion.[7/] These cuts will be driven by better management of operating theaters, improved care of patients with worsening conditions, enhanced administration and patient referrals, and the automation of document reviews and approvals prior to procedures being carried out, which will then streamline the processing of medical claims.

It is not just the healthcare industry that AI is expected to disrupt, and these technologies are likely to have significant impacts across the economy. A 2023 survey by PwC[8/] thus shows that within the Asia-Pacific region, 41% of respondents were optimistic about AI's ability to improve productivity, and 34% thought that AI will make it easier to learn new skills. Areas with the greatest potential to benefit from the AI revolution include the tech, telecoms, and financial services industries. The PwC Pulse Survey 2023[9/] also reveals that 59% of corporate executives planned to invest in emerging technologies connected to the cloud or AI in the next 12-18 months, while 46% planned to invest specifically in GenAI.

5/ https://storymaps.arcgis.com/stories/a6d2537e5acc40fe8dc1da4d6f741d3e

6/ https://webmedy.com/blog/new-technological-advancements-in-surgery/

7/ https://www.nber.org/system/files/chapters/c14760/c14760.pdf

8/ https://www.pwc.com/gx/en/asia-pacific/hope-and-fears/2023/asia-pacific-hopes-and-fears-survey.pdf

9/ https://www.pwc.com/us/en/library/pulse-survey/business-reinvention.html

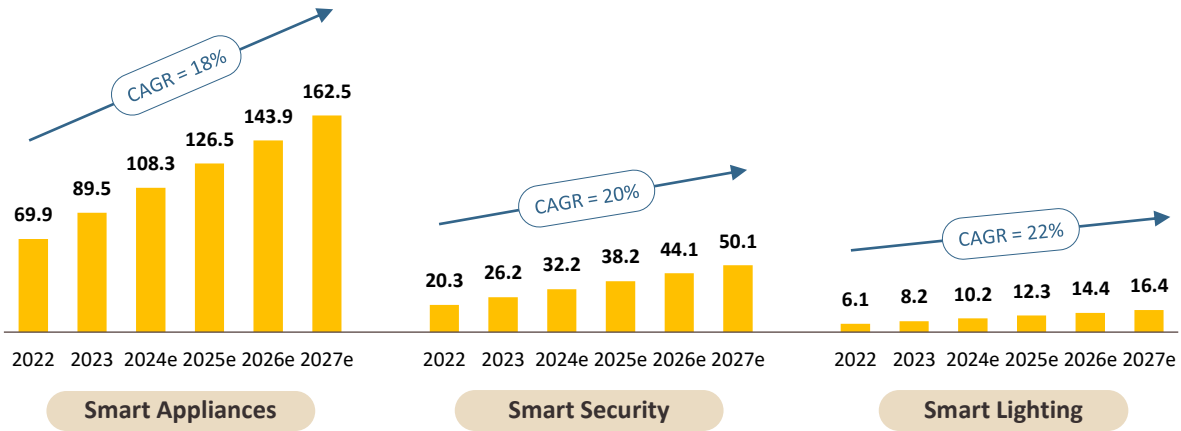
Outside healthcare, issues around **sustainability and the environment** are also becoming much more important on the global stage, and AI will have a role to play in this area, too. For example, AI can be used to instantaneously provide insights into the impacts of poor air quality and to recommend the correct preventative measures to take.[10/] Artificial intelligence can also be used to manage energy consumption and to cut greenhouse gas emissions by telecoms operators, with Nokia stating that AI will allow the company to reduce its energy consumption by up to 30%.[11/] Similarly, Google is using AI to build a smart traffic system that improves traffic flow and so reduces vehicle emissions.[12/]

Emerging technologies have in addition been used to develop smart homes, which deploy smart devices to **make normal day-to-day life easier** for consumers. Examples of these include voice-activated devices that can be used to perform commands such as turning lights on or off; AI-enabled electrical appliances, for example, smart fridges that remember shopping lists and the expiry dates of individual purchases and that can recommend recipes based on their current contents; and home security systems with AI capabilities that use facial recognition and motion detectors to alert owners to any unusual activities. Statista Market Insights estimates that the domestic market for home smart devices (including electrical appliances, security devices, and smart lighting) will grow by around 20% annually (CAGR) between 2022 and 2027. Such rapid growth clearly reflects strong demand and positive consumer sentiment towards the development of smart technology such as this.

Figure 4

Market Value Estimates of Various Types of Smart Devices for Thailand

(USD, mn)



Source: Statista, Krungsri Research

10/ https://www.unep.org/news-and-stories/story/how-artificial-intelligence-helping-tackle-environmental-challenges

11/ https://www.nokia.com/networks/bss-oss/ava/energy-efficiency/

12/ https://newatlas.com/transport/google-green-light-traffic/

Results of Krungsri Research survey on the public's hopes and fears around technology

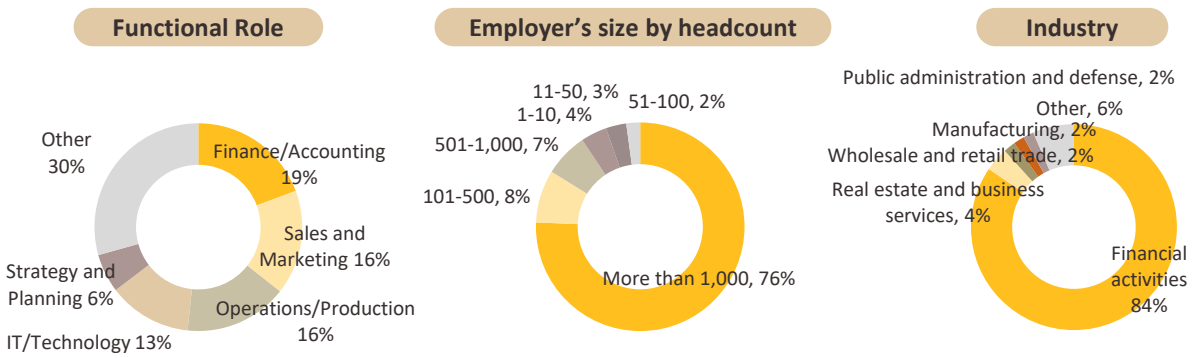
In the last quarter of 2023, Krungsri Research carried out a survey of the public's hopes and fears around emerging technology. A total of 1,578 survey responses were gathered from a mix of attendees at the Krungsri Tech Day: Together Now and Next,[13/] held on 11 October, 2023; and other respondents who completed the forms voluntarily between 17 and 31 October, 2023. The respondents all have different roles and responsibilities within their organizations.

I. Demographic Profile of Respondents

Because many responses were gathered at the Krungsri Tech Day, the overwhelming majority (84%) of respondents worked in banking and finance. The most frequently reported occupations were in finance and accounting (19%), followed by sales and marketing (16%), operations and production (16%), IT (13%), and strategy and planning (6%), with the remaining 30% in 'other' occupations. Besides, around three-quarters of respondents worked in organizations with more than 1,000 employees (Figure 5).

Figure 5

Demographic Profile of Respondents



Source: Krungsri Research

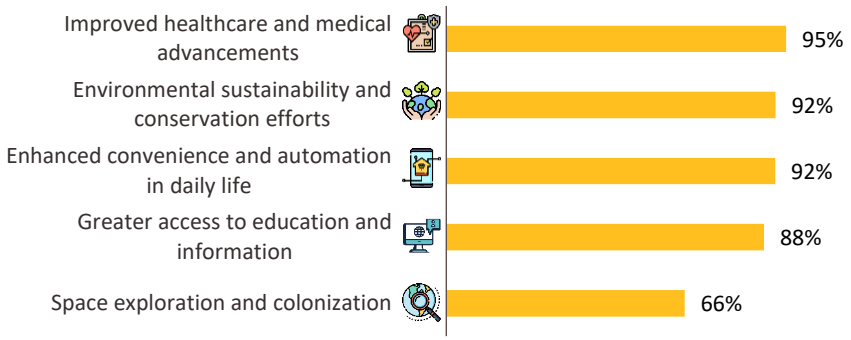
II. Hopes

The survey asked about respondents' hopes regarding emerging technologies in five areas. **95% of respondents reported being most excited about the potential benefits of emerging technology on improved healthcare and medical advancements.** This was followed in order by environmental sustainability and conservation efforts (92%), enhanced convenience and automation in daily life (92%), and greater access to education and information (88%). Excitement was lowest in using new technologies to help with space exploration and colonization, with only 66% interested in this (Figure 6).

13/ Krungsri Tech Day, held on 11 October, 2023, showcased digital banking solutions. For more details, please see: https://www.krungsri.com/th/newsandactivities/krungsri-banking-news/krungsri-tech-day-2023-together-now-and-next

Figure 6

Proportion of Interest in Emerging Technologies among All Survey Respondents



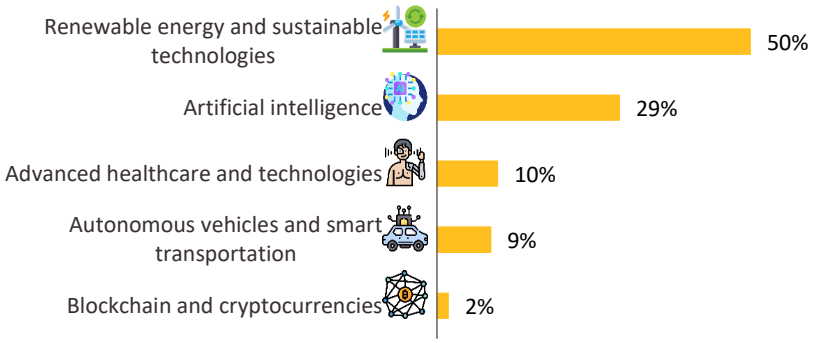
Source: Krungsri Research

Upon conducting an econometric analysis, it was found that, relative to other groups, those working in finance and accounting were 2.5-times more likely to be excited in the potential benefits of emerging technology on improved healthcare and medical advancements and twice as likely to be interested in increasing access to education and information. Staff officers (working in any area) were also 1.8-times more likely than executives to be excited about enhanced convenience and automation in daily life.

The survey also investigated respondents' views on the possibility that new technologies would generate benefits for society. It was found that half of the respondents (50%) believe that renewable energy and sustainable technologies will have the greatest positive impact on society overall. Following closely is Artificial Intelligence (AI) with 29%. On the other hand, blockchain and cryptocurrencies are seen by respondents as having the least potential to have a positive impact on society, with only 2% believing so, compared to other technologies (Figure 7). Moreover, when respondents are segmented by roles and responsibilities and organizational size,[14/] a consistent conclusion emerges: **renewable energy and sustainable technologies are widely perceived as having the greatest potential to positively impact society overall compared to other technologies, and those working in large organizations (with more than 1,000 employees) are 1.3-times more likely to hold this view than those working in smaller organizations.**

Figure 7

Proportion of Respondents' Hopes Regarding the Positive Impact of Various Emerging Technologies on Society Overall



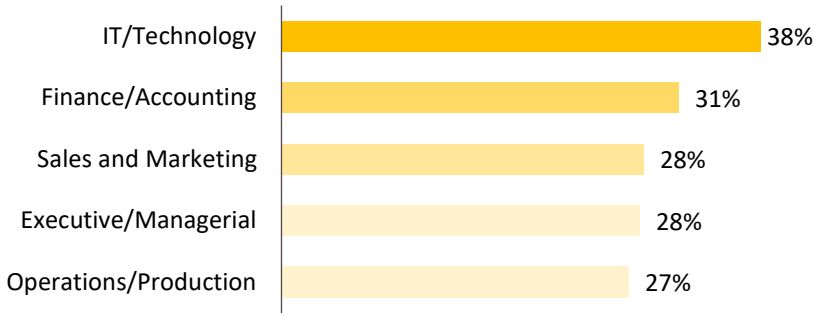
Source: Krungsri Research

14/ In this paper, the analysis was divided into two groups based on the size of the respondent's employer: (i) large organizations with more than 1,000 employees, and (ii) those general (smaller) organizations with 1,000 employees or less.

Although AI was believed to be the area second most likely to generate benefits for society, this view was not shared equally among all groups. At the top end, 38% of those working in IT held this view (Figure 8), **making this 1.6-times more prevalent than among those working in other areas. In addition, those working in smaller organizations that had not more than 1,000 employees were 1.3-times more likely to share this view than those employed by large organizations.**

Figure 8

Proportion of Respondents Believing that AI will Benefit Society, by Area of Work



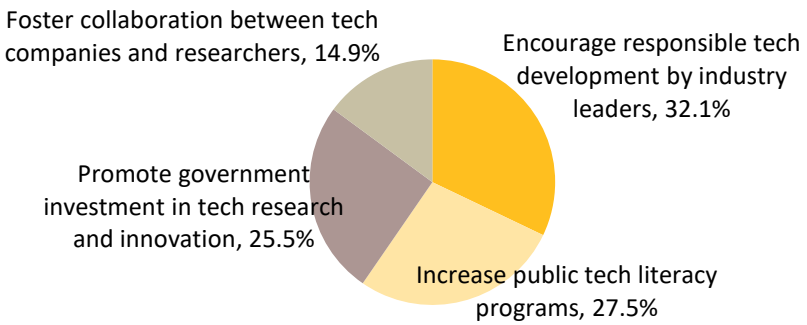
Source: Krungsri Research

Moreover, for emerging technologies to provide their full benefit, a range of supporting factors will also need to come into alignment. **The survey thus investigated views on what actions or measures could be taken to maximize the positive potential of emerging technology for society**, with respondents offered four choices to select from. **The most popular response was that large players within the industry should promote this development themselves, though this should be done in a responsible manner**, with 32.1% agreeing with this. This was followed by expanding public access to technology literacy programs (27.5%) and promoting government investment in technology research and innovation (25.5%) (Figure 9). As with other questions, **answers varied in line with respondents' area of work.** Executives and those working in finance and accounting saw large players within the industry being primarily responsible for its development, those working in IT placed the greatest emphasis on increasing public-sector funding, and those in operations and production were most in favor of expanding educational opportunities for the public.

However, analyzing the data in terms of organizational size revealed that in smaller companies (i.e., with 1,000 employees or less), **those working in IT favored increasing technology literacy programs. This may reflect the fact that in Thailand, staff working in smaller companies typically lack adequate opportunities for education and training relevant to new technologies.**

Figure 9

Measures to Ensure Emerging Technologies Deliver their Full Potential



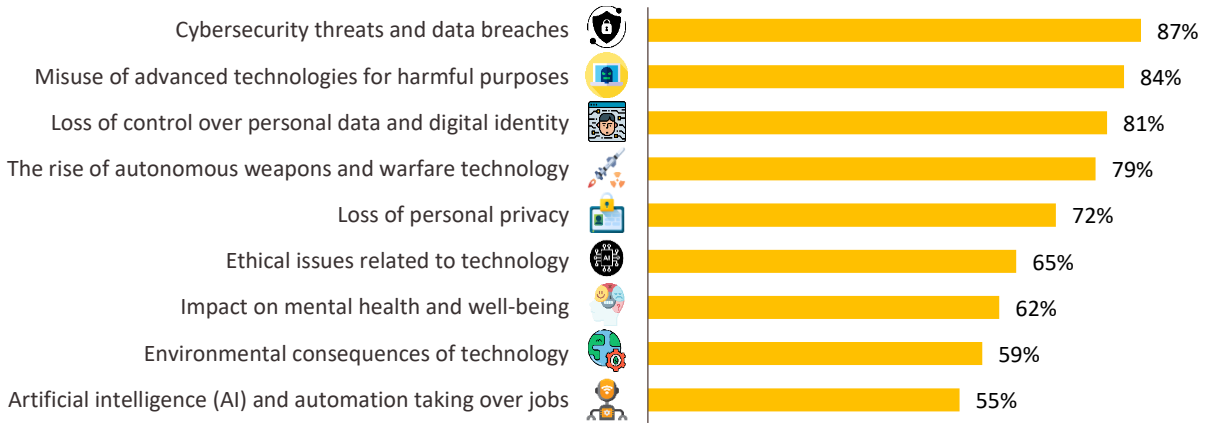
Source: Krungsri Research

III. Fears

Questions about respondents' greatest fears around emerging technology revealed that the five most commonly reported worries were: (i) cybersecurity threats and data breaches; (ii) potential misuse of advanced technologies for harmful purposes; (iii) an inability to access or correct online personal information or a loss of control over personal data and digital identity; (iv) the rise of autonomous weapons and warfare technology, which remains a worry despite not posing a direct threat to individuals; and (v) loss of personal privacy due to surveillance technologies. **The fact that cybersecurity threats and data breaches was the most widely reported fear may be connected to a lack of knowledge and skills in this area.** Research by the Office of the National Digital Economy published in 2023 shows that the Thai public generally lacks an understanding of the importance of ensuring that devices, accounts, and browsers are secure, of regularly updating their software, and of checking and confirming the reliability of online information.[15/]

Figure 10

Proportion of Respondents' Fears Relating to Emerging Technologies



Source: Krungsri Research

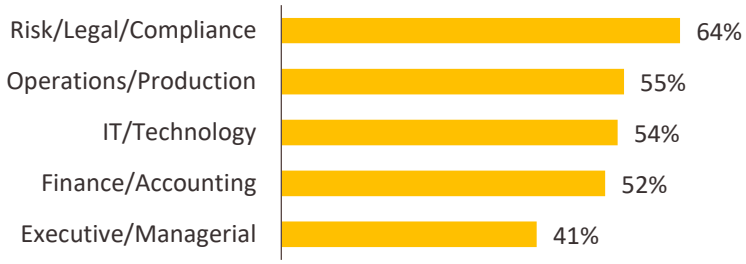
15/ For more details, please see: tdo.onde.go.th/documents/2023/01-A5-Infographic_TIME-202242_V11.pdf

Deeper analysis reveals that **those working in banking and finance were around 1.5-times more likely than others to express fears over cyberthreats and hacking**; while relative to IT workers, non-IT staff were 1.6-times more likely to worry about potential misuse of advanced technologies for harmful purposes and 1.4-times more likely to express fears[16/] over loss of control over personal data and digital identity. This therefore provides further evidence that **one important factor behind these worries could be a lack of IT skills and technology literacy.** In addition, staff officers were 1.7-times more likely than executives to worry about both potential misuse of advanced technologies for harmful purposes and loss of control over personal data and digital identity.

By contrast, worries that developments in AI and automation will lead to widespread job losses was the least concerning outcome for respondents, and just 55% saw this as being an important future concern. This fell to just 4 in 10 among executives, though for those working in areas related to risk, legal, and compliance, this rose to almost two-thirds (Figure 11).

Figure 11

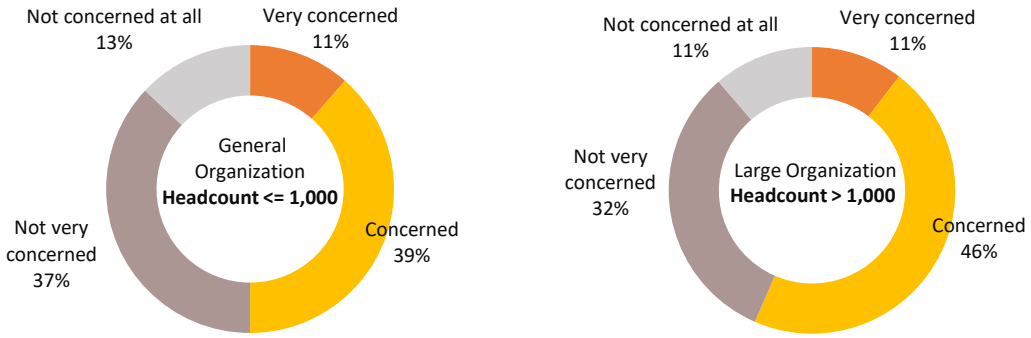
Proportion of Respondents Expressing Concerns[17/] over Job Losses Resulting from AI and Automation, by Area of Work



Source: Krungsri Research

Figure 12

Extent of Worries over Job Losses Resulting from AI and Automation, by Size of Employer



Source: Krungsri Research

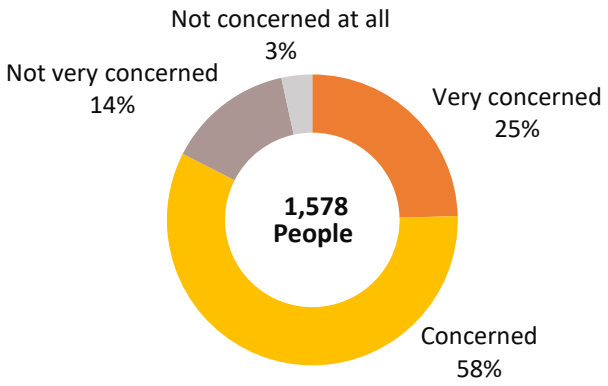
16/ Includes both those who were somewhat concerned and those who are very concerned.
17/ Includes both those who were somewhat concerned and those who are very concerned.

Further analysis shows that **those working in companies employing more than 1,000 staff were 1.3-times more likely than those in smaller companies to be worried about the impacts of AI and automation on employment (job losses), while for staff officers versus executives, worries over this rose to a difference of 1.7-times.** This is in line with research published overseas, including for example, 2023 work by the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) that shows that over 70% of US workers feel that AI will pose a threat to their employment. Worries are particularly strong among female workers, who fear that AI will worsen problems with equity in the workplace.[18/]

Questions of ethics are another important area of concern, in particular with regard to both Loss of personal privacy due to surveillance technologies and the bias that is built into AI systems. **83% of respondents therefore agreed that they were worried about the ethical implications of emerging technology,** though those working in large organizations with more than 1,000 employees were some 1.3-times more likely than those in smaller organizations to be worried about AI bias and accuracy, while individuals in banking and finance were around 1.4-times more likely to worry about ethical issues relating to emerging technologies than those in other industries.

Figure 13

Worries over Ethical Issues Related to Emerging Technologies



Source: Krungsri Research

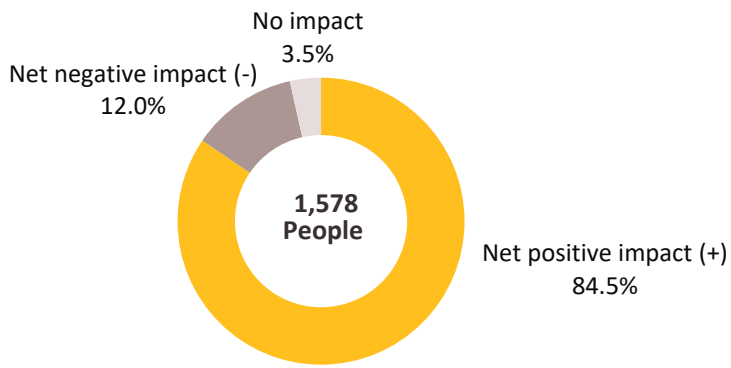
18/ https://aflcio.org/press/releases/afl-cios-shuler-state-unions-strong-record-public-support-unprecedented-activism-and

IV. Technologies in the banking sector

Although AI and automation clearly have the potential to provide benefits for industries across the economy, including banking,[19/] these changes also bring with them the risk of negative impacts. When answering questions on this, **84.5% of respondents said that they believed that AI and automation will generate positive benefits for the banking industry over the next 5 years**, while 12% thought the impacts would be negative, and 3.5% thought that this would have no impacts. However, when considering just those respondents who worked in banking and finance, **96% of individuals working in strategy and planning responded positively to this question, meaning that these individuals were 4.8-times more likely to hold this opinion than those in other groups.** This fell to 2.7-times for those in IT and 1.5-times for those in other areas related to back-office operations.

Figure 14

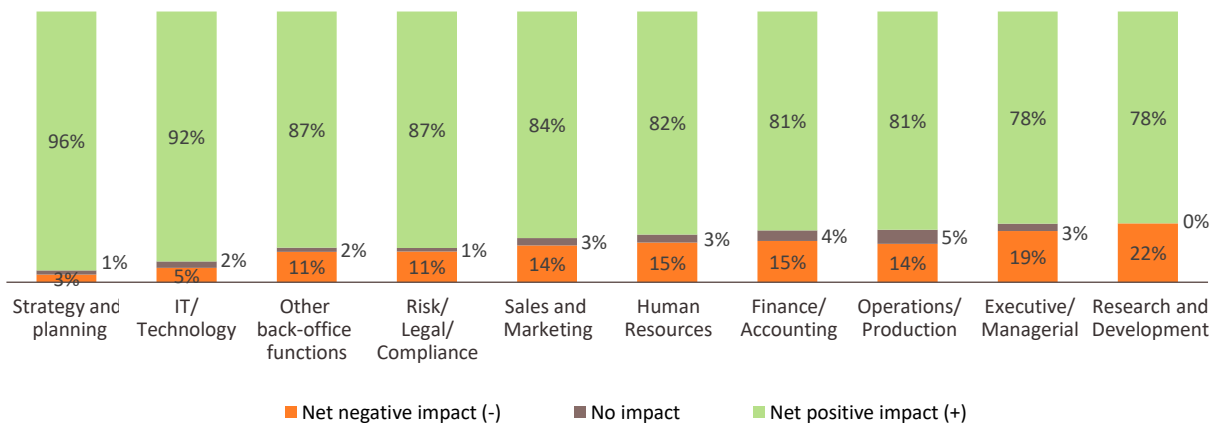
Expected 5-Year Impacts of AI and Automation on the Banking Industry



Source: Krungsri Research

Figure 15

Expected 5-Year Impacts of AI and Automation on the Banking Industry, by Area of Work



Source: Krungsri Research

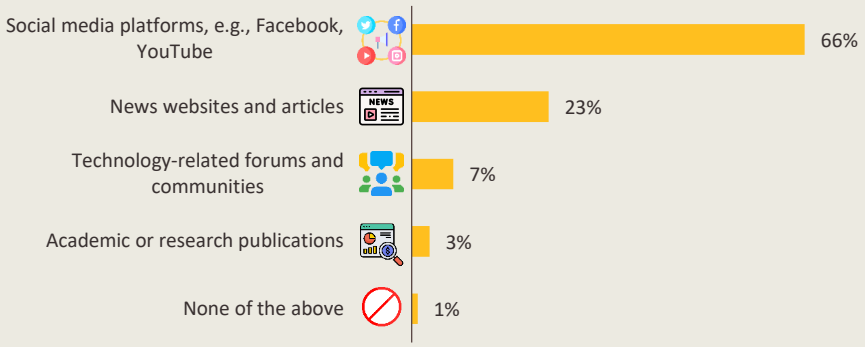
19/ For more details, please see: Tech Trends in the Banking Sector in 2023

Box 1 Favored Means for Learning about Risks Connected to Technology

Respondents' favored means for following news and sourcing information about risks relating to new technology was through social media platforms (used by 66%). This was followed in importance by news websites and articles (23%), but technology-related forums and communities and academic journals or research publications were largely ignored.

Figure 16

Favored Means for Learning about Tech-Related Risks



Source: Krungsri Research

Krungsri Research view

Attitudes of Thai people toward emerging technologies, both hopes and fears, may be influenced by various factors. These include personal experiences where individuals have become aware of or witnessed the misuse of technology leading to negative impacts. Lack of knowledge can also lead to fear of the unknown, while lack of technological skills may prevent individuals from maximizing benefits or controlling the appropriate and proper use of technology. The findings of this Krungsri research survey indicate that respondents view cybersecurity threats and data breaches as well as loss of personal privacy due to surveillance technologies as significant risks associated with emerging technologies. Therefore, **all stakeholders should collaborate to mitigate risks and promote proper and appropriate technology usage.** Looking at examples overseas shows that in countries that lead the market for technology, this often begins early, and in the case of the US, 27 states teach computer science at the high-school level.[20/]

As shown in Box 1, the survey also reveals that respondents favor social media and news websites and articles as sources of information about tech-related risks. Therefore, **efforts to increase knowledge and awareness about technology in general and the dangers associated with the adoption of new technologies in particular should be concentrated on these channels. Alongside this, high-quality content should be prepared for dissemination through these channels. Taken together, these efforts will allow parties to reach as much as 9 in 10 of the Thai public, resulting in clearly beneficial effects for Thai people in upgrading their understanding of issues related to new technologies.**

In addition, the survey throws light on the rising recognition of issues connected to the environment and how this will benefit from new technology. Thus, around 9 in 10 of executives expressed hope about how technology might be used to promote environmental sustainability and conservation efforts, **while individuals working in banking and finance were 1.7-times more likely than those in other sectors of the economy to share these hopes regarding technology and the environment.** This latter observation may reflect the role taken by the banking industry in pushing issues of sustainability to the fore over the past several years and the resulting increase in environmental awareness among banking staff. Beyond this, employees in large organizations were 1.3-times more likely than those in small companies (i.e., with 1,000 employees or less) to see the benefits of renewables and other sustainable technologies, and **this underscores the role that large corporations can play as leaders in the drive towards sustainability across society.**

Difficult matters related to ethics, justice and technology are a final important issue. At present, members of the public regularly have to deal with professional scammers operating online in various forms, though most often through criminal call centers that make use of personal information illicitly obtained from public- or private-sector sources. Organizations need to respond to these challenges by increasing their online security and tightening their operations, and highly secure zero trust[21/] technologies may offer one solution to these problems, thereby helping to increase confidence among both customers and the public generally that their data is safe. To build wider trust in the digital world, government agencies should also look to modernize the legal and regulatory environment, harden their cybersecurity, and ensure that punishments are in line with the nature of the offence. This will also help to reduce fears about new technologies that may be hindering their uptake, thus allowing society to enjoy the full benefits of technological progress.

Overall, if the public are provided with the requisite knowledge and skills, and if they are brave enough to fully embrace the potential offered by these emerging technologies, enormous benefits will be forthcoming for individuals, companies, and society at large, and this will then provide a major boost to the country's development.

20/ https://techhq.com/2024/02/computer-science-education-new-legislation-requirement/

21/ For more details, please see: Tech Trends in the Banking Sector in 2023

References

AFL CIO (2023): “State of the Unions is Strong with Record Public Support, Unprecedented Activism and Organizing this Labor Day”. Retrieved Jan 19, 2024 from https://aflcio.org/press/releases/afl-cios-shuler-state-unions-strong-record-public-support-unprecedented-activism-and

Chandler (2021): “Technology and its Impact on the Medical Field: The use of technology and how it has changed the way medicine is practiced”. Retrieved Feb 16, 2024 from https://storymaps.arcgis.com/stories/a6d2537e5acc40fe8dc1da4d6f741d3e

https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf

Nokia (2023) “How Artificial Intelligence reduces the carbon footprint of telco networks”. Retrieved Feb 19, 2024 from https://www.nokia.com/networks/bss-oss/ava/energy-efficiency/

PwC (2023): “Asia Pacific Workforce Hopes and Fears Survey 2023”. Retrieved Dec 20, 2023 from https://www.pwc.com/gx/en/asia-pacific/hope-and-fears/2023/asia-pacific-hopes-and-fears-survey.pdf

PwC (2023): “The new Essential Eight technologies: what you need to know” Retrieved Dec 7, 2023 from The new Essential Eight technology trends: PwC

Rice et al (2023): “The Stanford Emerging Technology Review 2023” Retrieved Dec 19, 2023 from https://setr.stanford.edu/sites/default/files/2023-11/SETR_web_231120.pdf

Rotolo et al. (2015): “What is an emerging technology?”. Retrieved Dec 7, 2023 from https://econpapers.repec.org/article/eeerespol/v_3a44_3ay_3a2015_3ai_3a10_3ap_3a1827-1843.htm

S. Cozzens et al. (2010): “Emerging technologies: quantitative identification and measurement” Retrieved Dec 7, 2023 from https://www.tandfonline.com/doi/abs/10.1080/09537321003647396

Sahni et al. (2023): “The Potential Impact of Artificial Intelligence on Healthcare Spending”. Retrieved Feb 17, 2023 from https://www.nber.org/system/files/chapters/c14760/c14760.pdf

Saini (2023): “New Technological Advancements in Surgery”. Retrieved Dec 12, 2023 from https://webmedy.com/blog/new-technological-advancements-in-surgery/

TechHQ (2024) “Kids must code in California”. Retrieved Feb 19, 2024 from https://techhq.com/2024/02/computer-science-education-new-legislation-requirement/

United Nation (2023): “Science & Emerging Technology”. Retrieved Dec 7, 2023 from https://libraryresources.unog.ch/c.php?g=673842&p=4792828

World Economic Forum (2023): “Top 10 Emerging Technologies of 2023”. Retrieved Nov 17, 2023 from https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf

Office of the National Digital Economy and Society Commission (2023) Thailand Digital Outlook 2023 from https://tdo.onde.go.th/documents/2023/01-A5-Infographic_TIME-202242_V11.pdf

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