Technology Landscape:
Other Technologies and Technology-related Areas

Introduction

This publication forms part of the IESBA's Technology Working Group's Phase 2 Report, which documents the impacts of disruptive and transformative technologies on the work of professional accountants, and provides extensive analysis and insights into the ethics dimension of those developments.

Specifically, this publication surveys the technology landscape in relation to Other Technologies and Technology-related Areas and summarizes the outcomes of the Working Group's fact-finding into the trends, opportunities, and impact/ risks related to ethics implications of such technologies.

The Working Group comprises Brian Friedrich, IESBA Member and Chair of the Working Group; Vania Borgerth, IESBA Member; David Clark, IESBA Technical Advisor; Christelle Martin, IESBA Member; and Sundeep Takwani, former IESBA Technical Advisor.

The full Phase 2 Report also discusses the relevance and importance of the overarching principles and specific provisions in the *International Code of Ethics for Professional Accountants (including International Independence Standards)* (the Code) in laying out the ethics guardrails for professional accountants as they face opportunities and challenges in their work as a result of rapid digitalization.

This publication does not amend or override the Code, the text of which alone is authoritative and reading it is not a substitute for reading the Code and is not intended to be exhaustive and reference to the Code itself should always be made. This publication does not constitute an authoritative or official pronouncement of the IESBA.

Technology Landscape

This section covers the trends, opportunities, and impact/risks of the following technologies and related issues: Robotic Process Automation (RPA), AI, blockchain, cloud computing, and data governance, including cybersecurity. Key ethics-related concerns arising from these technologies and issues are covered in the subsequent subsection entitled *C: Potential Ethics Impact on the Behavior of PAs*. The Working Group notes that most of the ethics-related impact/risks and key concerns are addressed by provisions in the extant Code and proposals in the Technology ED. Those that the Working Group believes can benefit from further guidance are outlined in *Section III: Insights and Recommendations*.

Stakeholders report that the most common emerging technologies and technology-related issues currently impacting business processes are RPA, AI (including intelligent process automation (IPA)),[1] cybersecurity (including data privacy), and blockchain. It was consistently reported, however, that the uptake by organizations of AI and blockchain-related technologies is slower than expected and slower relative to the publicity these technologies receive. Based on stakeholder and TEG commentary, as well as

desk research, it appears that most organizations are finding these technologies challenging to effectively implement as a result of process fragmentation, resources being allocated to other priorities, difficulties in establishing business cases (for example, a lack of understanding of the return on investment (ROI) arising from the technology or a belief that the ROI is too slow), and the general lack of maturity, and accordingly lack of understanding, of the technologies.

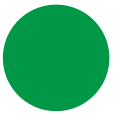
Nevertheless, accelerated implementation of transformative technologies has been observed – particularly in the past couple of years – often connected with mitigating business issues related to the COVID-19 pandemic, such as RPA, cloud computing, tools to support remote working and access, and addressing cybersecurity concerns.

Other Technologies and Technology-related Areas

1. This section highlights other technologies[2] that the Working Group encountered at a high-level during its fact-finding.

(**GREEN:** Already here; **ORANGE:** On the horizon, i.e., emerging; **BROWN:** Nascent, i.e., still largely theoretical and under development):

Maturity	Technology	Opportunities	Impact/Risks
	Synthetic media: Recordings or live presentations (video or audio) that use AI to create "fake" content or "deepfakes"	Use of deepfake "artificial reality identities" to connect with clients and make presentations[3] Training simulations for education and evaluation Reaching and engaging with larger, more diverse audiences in an efficient way Opportunity for NFTs as it can facilitate determining the authenticity of a physical or digital asset (i.e., virtual/digital content such as photos, videos, audio, or tweets) because the original source of such videos will be tagged in the blockchain underlying the NFT[4]	Prevalence of mis-/disinformation[5] to shift public opinion in spite of factual and evidence-based information to the contrary, and resulting challenges in undoing viral social media posts that present such information Use of deepfakes to commit fraud, for example, consider a deepfake of a senior executive at a company or an audit partner commenting on sensitive information circulating around social media[6] Identity theft poses a threat to authorization processes Increased need for being alert and applying professional skepticism and having an inquiring mind
	Internet of Things (IoT): Any device (with a built-in sensor) connected to the internet, creating a network of connected devices that collects and shares data about the people and/or environment around it	Helps to collect and generate data that was previously not available or easily accessible, improving visibility and allowing for improved data analytics, especially when coupled with AI[7] Remote asset management and monitoring, such as location tracking, including autonomous driving applications Improve asset utilization, such as through predictive maintenance of industrial equipment and increased operational efficiencies through IoT-based process automation Common examples of usage in everyday life already include smart home and wearable devices	Privacy and related issues relating to data collected[8] (i.e., could be of sensitive nature such as health data, have varying legal implications across jurisdictions) and "new" risks such as the inadvertent collection of data from such devices Expands the "attack surface" to penetrate a secure network,[9] see discussion on *Focus on Data Governance* Challenges in quality control and compatibility (i.e., huge numbers of IoT devices that have different standards of quality and security) as well as connectivity (i.e., bandwidth) impact the successful functionality of IoT[10]

Maturity	Technology	Opportunities	Impact/Risks
	Digital 5G: The 5th generation of mobile networking with dramatically faster (i.e., by an anticipated 8 to 16 times) upload and download speeds than 4G networks	Predictive intelligence in smart industrial settings and smart cities, including ties to sustainability[11] Enhanced mobile broadband and speeding up large data transfers Accelerating the development and deployment of IoT applications, including edge computing[12]	Increase in 5G mobile powered digital transactions means that companies will need a streamlined way to authenticate users. Digital authentications will need to be more versatile, more frequent and more frictionless than before[13]
	Immersive digital worlds ("metaverse"): Enabled by augmented reality ("AR", which augments real-world scenes with additional information overlays) and/or virtual reality ("VR", which creates a completely virtual environment)	Professional education and evaluation through simulations Specific to audit firms, the pandemic has seen an increase in using AR and drones for remote inventory counting. Nevertheless, uptake is still slow mainly driven by reluctance from regulators and jurisdictional legislation that might not allow virtual inventory taking	Data privacy, cybersecurity concerns, and lack of identity verifiability[14] Questions over harassment and discrimination in virtual worlds and the lack of research on the physiological impacts on humans of prolonged immersion in VR/AR environments[15] Transactions, many speculative at this point, that are conducted in the metaverse will also have tax and financial reporting implications that are evolving
	Edge Computing: Real-time processing of data at the source by combining the use of IoT with cloud computing	Distinguished from cloud computing, which aggregates data collection from sources before processing it in the cloud Improving response times and decision-making, and saving bandwidth by bringing computation closer to the source of data (i.e., important when facing today's supply chain issues) Allows continuous learning and optimization of the process as data is processed in real-time	See discussion on *Technology Landscape*: *Cloud Computing*
	Web 3.0: Envisioned as the third generation of the internet built on a decentralized distributed ledger (i.e., blockchain) and where users can create and own their own data. Web 2.0 is today's internet built mainly on Javascript and HTML5, which allows user interaction but where relatively few companies own user data, i.e., large technology companies[16]	No central authority controlling the collection, ownership, and flow of information Facilitates blockchain technology and concepts, including digital identity, smart contracts, DeFi and decentralized applications (dApps).[17] See section above on *Technology Landscape*: *Blockchain* – Cryptocurrencies, Tokens and Decentralized Finance	The notion of a "creator" economy will mean a rise in NFTs that serve as products or services which can be bought and sold on the blockchain underlying Web 3.0. Presents questions over data security; data ownership; digital identity; and the identification and mitigation of fraudulent transactions, programming bugs and errors, etc. See also discussion on *Technology Landscape*: *Blockchain* – Cryptocurrencies, Tokens and Decentralized Finance

Maturity	Technology	Opportunities	Impact/Risks
	Quantum computing: Emerging technology that harnesses the laws of quantum mechanics to solve problems "too complex" for today's computers[18]	Where today's supercomputers use a "two-dimensional" approach to solve statistical problems, quantum computing is anticipated to allow a new multi-dimensional approach to solving statistical problems, meaning that its computing power has increased significantly and can take into account an exponential number of multiple variables and uncertainties as compared to today's computers Will innovate different method/approach of encryption in face of such massive computing power	Impact on cybersecurity due to the increased computing power that will effectively render all of today's public-key encryption systems "useless". Accordingly, there will be a need to upgrade the technical security for every organization and entity[19]
	Homomorphic encryption, part of a wider group of technologies called Privacy Enhancing Technologies (PETs): Allows data to be securely and privately used throughout its lifecycle without the need to decrypt it, meaning that different parties can be given access to work directly on the encrypted data without ever seeing the raw data[20]	Allows businesses to comply with various jurisdictional data protection laws Enables data testing by third parties[21] as PETs facilitate privacy protection while data sharing Protects against privacy breaches that could potentially severely harm business reputation	Computation overhead needs to be significantly decreased as it is still very slow, so not yet practical to use for many applications[22] Additionally, integration challenges between data collection points, i.e., IoT (typically designed to consume low energy and storage), and PETs (running PETs typically requires greater computational power) Trade-off between utility and privacy, presenting questions over data authenticity and integrity and reducing transparency in data, for example, impacting the assessment of data used to train AI models
	Cognitive AI: AI with cognitive abilities more similar to a human, including the ability to make decisions in unforeseen environments	Ability to mimic human behavior and respond to complex problems. See the section above on *Technology Landscape*: *AI*	Cognitive AI will impact decision-making and whether such decisions made by AI have human oversight, are understandable and explainable. See discussion on *Technology Landscape*: *AI*

Endnotes

1 IPA refers to the application of AI (including its sub-fields of computer vision, machine learning, etc.) to RPA.

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ABOUT THE IESBA

The International Ethics Standards Board for Accountants (IESBA) is an independent global standard-setting board. The IESBA serves the public interest by setting ethics standards, including auditor independence requirements, which seek to raise the bar for ethical conduct and practice for all professional accountants through a robust, globally operable International *Code of Ethics for Professional Accountants (including International Independence Standards)*.

The IESBA believes a single set of high-quality ethics standards enhances the quality and consistency of services provided by professional accountants, thus contributing to public trust and confidence in the accountancy profession. The IESBA sets its standards in the public interest with advice from the IESBA Consultative Advisory Group (CAG) and under the oversight of the Public Interest Oversight Board (PIOB).

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