EMBRACING DIGITAL TRANSFORMATION IN ACCOUNTING & FINANCE

SMU SINGAPORE MANAGEMENT UNIVERSITY | School of Accountancy

CPA AUSTRALIA

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Embracing Digital Transformation in Accounting & Finance

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FOREWORD

Digital transformation in the finance and accounting industry has been accelerated by the onset of the COVID-19 pandemic that reshaped business models and organisations globally. For many organisations, the impetus was clear – digital adoption and transformation were major enablers for businesses to survive and thrive even as societies went into lock-downs to manage the public health crisis.

What are the ways that organisations have adopted technology in the last year? How can organisations ensure sustainable digital transformation? This book aims to share practical applications and knowledge with organisations as they progress in their digitalisation journey. In particular, accounting and finance professionals, directors and senior management in corporations and small-and-medium-size enterprises (SMEs), as well as business advisors, will find this book useful in their roles as strategic business partners.

This publication brings together the industry knowledge from subject matter experts in accounting, business and academia.

We are grateful for the generosity of time and the effort by our contributors from Accenture, Deloitte, EY, FTI Consulting, KPMG, OCBC, PwC Singapore, RSM, Singapore Management University (SMU), and WongPartnership in providing their valuable insights. We also thank the staff of CPA Australia and SMU who have supported the production of this book.

We hope that this resource on digital transformation in accounting and finance will be a helpful guide in increasing the ability of your organisation to implement a successful and sustainable digital strategy to transform the finance function.

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July 2021

PROLOGUE

Digital transformation involves the integration of digital technologies and business processes. Recent developments in digital technologies have provided organisations with the tools to embark on digital transformation encompassing a wide range of business processes and activities. Organisations that can leverage on technology to digitally transform themselves stand to put themselves at a significant competitive advantage relative to their competitors.

Certainly, the COVID-19 crisis has magnified the need for organisations to embark on digital transformation. A recent survey by McKinsey & Company suggests that companies have accelerated the digitisation of their customer and supply-chain interactions and of their internal operations by three to four years while the share of digital or digitally enabled products in their portfolios has accelerated by seven years.

As editors of this book, we have assembled authors with a diverse range of expertise to provide important insights in the area of digital transformation. Together with the authors, we explore the impact that digital transformation has on the accountancy profession and how organisations can develop a digital transformation strategy. We also discuss how digitalisation can be applied to different aspects of accounting and finance, and how we can groom the next generation of accountants who possess the skills to thrive in an era of digitalisation.

We hope that the issues examined in this book will contribute to the academic and professional literature, and serve as a useful resource for organisations as they embark on their digital transformation journeys. We also hope that the book will encourage robust discussion on the opportunities and challenges that digital transformation will bring to the accountancy sector.

This book is organised as follows.

Many organisations today actively incorporate sustainability principles into their business strategies. **Chapter 1** highlights how digital innovation can be both a catalyst and enabler of business sustainability. Using three case studies taken from a diverse range of settings, the chapter illustrates how organisations can leverage on the potential of digital innovation to meet their sustainability goals.

Chapter 2 focuses on the application of data analytics in audit and discusses how it can improve the traditional audit process. Analytics, when designed and executed right, can greatly improve the quality, efficiency, and value of financial statements audits. When embedded in a financial statements audit, analytics enable auditors to examine larger populations and conduct more effective, focused testing.

As the adoption of artificial intelligence (AI) and other related technologies becomes more prevalent, organisations will increasingly need accountants who have relevant technology skill sets that surrounds data and insights derived from that data. **Chapter 3** explores the opportunities and challenges associated with AI adoption and highlights key considerations for finance and accounting professionals. It also documents the potential benefits that the finance function can reap from the application of AI.

Over the past decade, cybersecurity has become a significant consideration for many organisations. **Chapter 4** explores and discusses the importance of cybersecurity to organisations. It also highlights key considerations for organisations in the implementation of cybersecurity.

While blockchain technology is disrupting every sector, the financial services sector is leading the way in blockchain adoption. **Chapter 5** discusses how blockchain technology works, key opportunities, and challenges to its application in the financial services sector. It also explores blockchain adoption and innovation through use cases within financial services segments such as lending, trade finance, asset management, and insurance.

Organisations embarking on digital transformation often seek to incorporate robotic process automation (RPA) into their processes. **Chapter 6** introduces RPA and explains the benefits that organisations can reap from RPA in terms of efficiency and effectiveness. It also highlights how RPA can be integrated with other emerging technologies and techniques to perform more complex tasks requiring some form of cognitive ability or high-level thinking.

Chapter 7 discusses enterprise resource planning (ERP) platforms and cloud technology, and how they can position the finance function for growth. It explains how a robust digital core and cloud strategy can help organisations address challenges arising from broad industry shifts, and ultimately empower the CFO in his/her critical role as an economic guardian, an architect of business value and a catalyst of digital strategy.

Chapter 8 examines key tax issues that may result from digital transformation. In the local context, such issues relate to general income tax treatment, income tax considerations for e-commerce, withholding tax, GST considerations for e-commerce businesses, GST on imported services, and digital tokens and initial coin offerings. In the international context, such issues relate to permanent establishments, and the OECD and G20 Inclusive Framework on Base Erosion and Profit Shifting.

Within the context of digital forensics investigations, there are clear signs that courts and regulators have become more accepting of technology such as data analytics and artificial intelligence. **Chapter 9** explores the application of digitalisation in accounting as it relates to digital forensics investigations. In particular, it highlights how new tools and discovery methods can complement existing forensically-sound approaches and deliver intelligible visualisation with comprehensive information to digital forensics investigators for further interrogation and analysis.

Chapter 10 examines how organisations can create a digital strategy. It explains how anchoring on the "three-Ds" of Digital, Data, and Design can help an organisation to propel its digital strategy, leading eventually to increased trust between customers and the organisation.

Finally, **Chapter 11** highlights the need for accountants to develop new paradigms and skills in order to effectively leverage technology. Using the case study of an Accounting Data and Analytics Second Major Programme, it illustrates how universities can incorporate technology into their curriculum to benefit students by equipping them with relevant skillsets required for accountants of the future.

We are pleased to be part of this collaboration between CPA Australia and SMU School of Accountancy Research (SOAR) Centre. We thank the contributing authors for supporting this project, and hope that you, the reader, find this collection of articles a practical resource.

DIGITAL INNOVATION: A CATALYST AND ENABLER OF ACHIEVING BUSINESS SUSTAINABILITY

CHAPTER 1

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Business sustainability

Today, many companies are actively incorporating sustainability principles into their business strategies. This movement is likely to have resulted from an ongoing shift in the demands and behaviours of customers, employees, partners, governments, investors and other stakeholders that expect companies to act with integrity and in a way that benefits wider society. The emphasis on achieving sustainability goals has led to increasing adoption of "triple bottom line", which suggests that companies ought to pay attention to more than just the bottom-line, but also measure their environmental and societal impacts that may help to achieve long-term business growth. Typically, companies with high environmental, social, and governance (ESG) ratings have consistently outperformed the market in medium and long term horizons[1].

A recent survey on business sustainability[2] has reported that 73 per cent of global consumers, particularly millennials, were willing to alter their consumption habits to minimise negative impacts on the environment. In addition, sustainable product sales had grown by nearly 20 per cent yearly. In light of this development, more companies have embarked on a journey to establish sustainable business objectives and practices. For instance, Unilever has committed to only using palm oil from certified sustainable sources. The company has been working closely with its stakeholders to lead an industry-wide adoption of sustainable palm oil. Despite such commitment, Unilever's business continues to thrive and the world has reaped the environmental benefits of sustainable palm oil harvesting practices. This example shows that in order to facilitate sustainable growth, today's business must strive to create positive societal impact. It will be increasingly challenging for a company to remain a viable brand with good reputation if its business practices in some way exacerbated inequality or exploited natural resources.

To date, digital technologies have played a useful role in enabling business sustainability. For instance, the main output of digital technologies is information rather than physical goods. Therefore, digital technologies contribute by reducing the emissions and physical waste that emanate from almost every sector of the economy. However more can be done to integrate digital innovation with sustainability practices. To achieve sustainability objectives, it is therefore crucial to utilise the full potential of digital innovation, with active digital cooperation and interaction among stakeholders in the ecosystem.

Digital sustainability

Digital sustainability refers to a holistic approach a company can take in achieving better sustainability through wise technology investments. It involves organizational activities that seek to advance sustainable development goals through creative deployment of technologies that create, use, transmit, or source electronic data[3].

The examples below illustrate how Internet of Things (IOT), blockchain and big data analytics play active roles in enabling sustainable practices and objectives[4].

[1] *Sheila Bonini and Steven Swartz (2014) Profits with Purpose: How Organizing for Sustainability can benefit the Bottom line. Mckinsey & Company. https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Profits%20with%20purpose/Profits%20with%20Purpose.ashx. Accessed on 4 May 2021*

[2] *Nielsen (2019) A Natural Rise in Sustainability around the World. https://www.nielsen.com/eu/en/insights/article/2019/a-natural-rise-in-sustainability-around-the-world/. Accessed on 5 May 2021*

[3] *Gerard George, Ryan K. Merrill., and Simon, J. D. Schillebeeckx (2019) Digital Sustainability and Entrepreneurship: How Digital Innovations are helping Tackle Climate Change and Sustainable Development, Entrepreneurship Theory and Practice, 00(0), 1-28.*

[4] *Sykes, Nathan (2019) What is New in Digital Transformation? How about Digital Sustainability? https://www.thedigitaltransformation people.com/channels/enabling-technologies/whats-new-in-digital-transformation-how-about-digital-sustainability/. Accessed on 7 May 2021*

IoT and Sustainability Solutions. IOT is an expressway within companies' existing architecture that channels mission critical data from one end of operation to the other. It is becoming increasingly common for companies to apply IoT technologies to existing networks and assets in order to achieve significant time and cost savings. For example, smart heating, ventilation, and air conditioning systems may optimize performance across a building's physical environmental controls, turning on and off according to occupancy or interfacing with company or personal schedules. With the cyber-physical systems design mindset becoming more popular, one would envisage more digital technologies will be entwined with mechanical systems and information infrastructure to offer sustainability solutions.

Blockchain and Supply Chain Sustainability[5]. Blockchain functions as a database of public ledger for all transactions that integrates with a distributed time-stamping server and a peer-to-peer network. The transaction records, called blocks, are linked with one another. It is important to note that transaction records, captured by the distributed ledger, are permanent and verifiable.

In supply chain, each block or packet of transaction records is related to a stakeholder ranging from a raw material supplier to producer to wholesaler to retailer. At each stage, a new permanent block of information is created. Each block is sent to all supply chain participants to verify and is then added to the chain. Subsequent stakeholders such as retailers, would contractually be permitted access to agreed-upon data in the previous blocks, such as product origin, temperature control or other business-critical information. This would provide important visibility into supply chain operations.

A major benefit of blockchain is that it helps to improve visibility in sustainable supply chains. Through blockchain ledger, all parties involved in a transaction, the state, quality and price of the products as well as the date and location of the transaction will be identified. The availability of information about the product to all parties helps to ensure data integrity. As blockchain is decentralized in structure, no single party will be able to have ownership of data or manipulate it for his or her personal advantage. The immutable and cryptography-based nature of data will make it completely impossible to compromise the ledger. From manufacturing to the final sale of the product, every time a product changes hands, the details will be documented in the blockchain database, so there will always be a permanent history. The unique nature of blockchain can help identify and correct contract violations, redundancies, and bottlenecks in the flow of goods. From a supply chain sustainability perspective, such visibility will ensure efficient transactions, while promoting food safety, efficient recalls, the elimination of counterfeits, and the assurance of ethical trading partners.

While blockchain technology looks promising in enhancing supply chain, some academics have raised the worry of bitcoin mining, enabled by blockchain technology, contributing to enormous energy consumption[6]. This perception has somewhat affected rapid adoption of blockchain technology by businesses[7].

[5] *https://www.thebalancesmb.com/blockchain-and-supply-chain-sustainability-4129740*

[6] *Dittmar L, and Praktiknjo A (2019) Could Bitcoin Emissions Push Global Warming above 2C? National Climate Change, 9(9), 656–657*

[7] *Sedlmeir, J., Buhl, H.U., Fridgen, G., and Keller, R. (2020). The Energy Consumption of Blockchain Technology: Beyond Myth. Business & Information Systems Engineering, 62, 599–608*

Big Data Analytics. From a digital sustainability perspective, big data could help a company such as Philips Electronics, to gain a better understanding of how consumers interact with their products after the sale, and whether, where, how and why they engage with the "secondary market" for repairs, replacement parts, maintenance or modifications. By leveraging data from secondary market, Philips Electronics has discovered ways to better work with consumers and companies to extend the lifetime of their electronic devices such as electric shavers and X-rays. Instead of simply dumping these used devices in the landfill if they still have some usefulness left, making product service, maintenance and repair parts easier to handle, extends the company-customer relationship and potentially opens up new revenue streams. As a result, Philips Electronics is able to pursue greater efficiency, lower costs and a longer and more productive relationship with its core customers. The best part of such data-driven insights is that it helps to achieve better profitability and also lead to a healthier planet.

Digital sustainability case study 1: SATS's digital integrated supply chain[8]

SATS is the chief ground-handling and in-flight catering service provider at Singapore Changi Airport. It controls about 80 per cent of Changi Airport's ground handling and catering business. SATS maintains an extensive and complex supplier network with more than 3,700 suppliers globally. Its suppliers range from farms in Singapore to multinational companies. SATS strives to establish sustainable practices and production methods as the company firmly believes that a sustainable supply chain is one that not only benefits its customers and its business' long-term viability, but also supports its suppliers' livelihoods and protects the environment.

To enhance visibility and traceability along the supply chain, SATS has invested in Digital Integrated Supply Chain (DISC) to build its capability in realising full traceability, centralised procurement and distribution. The purpose of DISC is to enhance demand and procurement planning as well as production efficiency. With improved batch traceability and quality assurance integration, DISC assures SATS' customers of the origins of their meals. In addition, the robust supply chain allows quick identification and remediation of root causes of defective products, hence improving the level of service recovery and product quality that SATS offers to its customers.

By collaborating with a third-party logistics provider, DISC is able to offer improved inventory planning and forecasting to its airline customers, allowing SATS to augment the passenger experience with a wider range of food & beverage offerings and amenities. DISC also allows SATS to accelerate end-to-end traceability of raw materials for its customers, and deploy data analytics to achieve greater efficiency and quality, while reducing food waste. Figure 1 below illustrates SATS' Digital Integrated Supply Chain.

[8] *https://www.sats.com.sg/sustainability/sustainability-reports*

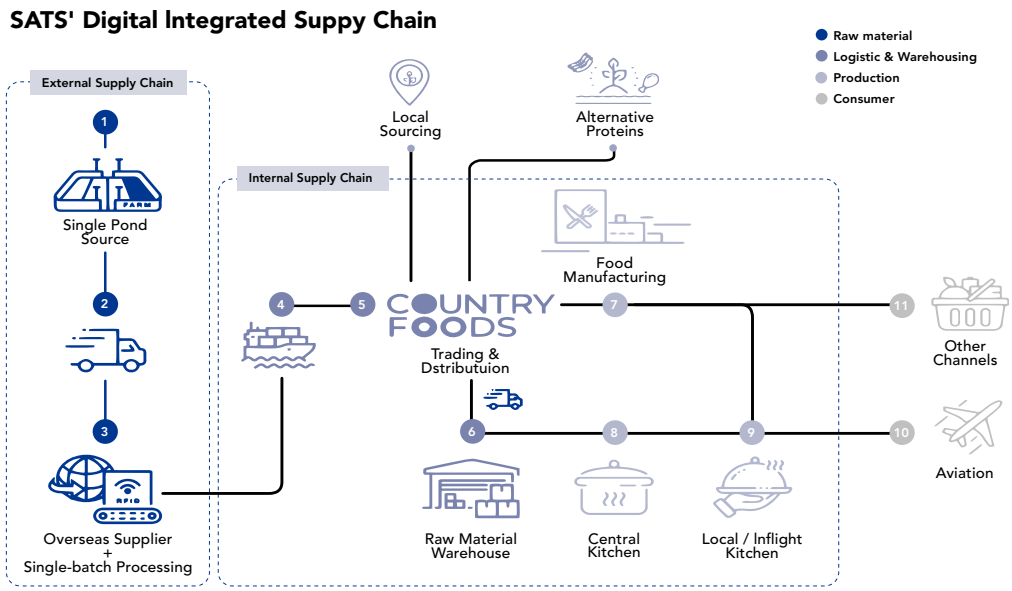

Figure 1: SATS' Digital Integrated Supply Chain

Digital sustainability case study 2: Twiga food supply app[9]

A banana farmer in Kenya, Mary Murthoni Ndon'go, used to struggle to get a fair price for the bananas she grows. According to her: "we used to sell to brokers. The brokers come and take big bananas for only $200 or $300 Kenyan Shilling. They often say they sell at a loss at the market. So they give us as little money as they feel like."

Over 75 per cent of Kenya's population makes some part of their living from agriculture. However, the Kenyan agricultural sector can be inefficient and complex, and food waste is high due to inefficient handling practices. At the same time, small- and medium-sized fruit and vegetable vendors often lack access to a reliable supply of affordable and quality products.

A mobile-based cashless business-to-business food supply app called Twiga, was created in 2014 to connect Kenyan farmers directly to vendors paying farmers twice as much money as they would normally make for their produce. As of January 2018, the platform has become the largest seller of bananas in Kenya. It has sourced more than 245 tonnes of bananas each week from over 3,000 farmers. These bananas are distributed through 7,000 weekly deliveries to more than 3,500 registered vendors who re-order every two days, on average. The app has reduced typical post-harvest losses in Kenya from 30% to 4% for produce brought to market on the Twiga network.

"Think about in some of these economies, if you're spending 55% of disposable income on food, if that number were to go down to 40% — because of…gaining efficiency — what you've done is to release 15% for consumers to spend on other things." said Njonjo, the co-founder of Twiga.

[9] *Business Insider Today, 12 Oct 2019. How an App Helps Kenyans Get Higher Quality Food and Pay Farmers Fairly. Accessed on 10th May 2021*

What makes this digital innovation all the more impactful and sustainable is that it is life changing as it has prevented Kenyan banana farmers from entering a poverty situation. These farmers now have reasonable compensation for their labour which represents a stable source of income. From a societal perspective, the digital platform has helped to ensure responsible consumption and production as it reduces post-harvest losses and waste by matching demand and supply. There is no doubt that digital innovation has helped to improve existing supply chain and catalyses supply chain restructuring.

Digital sustainability case study 3: Air pollution management system in Beijing-Tianjin-Hebei region in China[10]

Big data analytics can play a major role in managing air pollution. A good example is air pollution management in the Beijing-Tianjin-Hebei (BTH) region in China. The BTH region is home to eight of China's 10 smoggiest cities. In China, air pollution accounts for an estimated 1.1 million deaths per year, while the annual costs of death, suffering, and decreased food production due to air pollution are approximately US $38 billion. As one of the greatest sustainability challenges, air pollution management has attracted much attention from the Chinese government and the public. The governments in the BTH region have been collecting huge amounts of data to monitor and predict air quality in real time and are exploring ways to generate novel data driven insights for air pollution management.

By putting in place air pollution monitoring systems at many sites in the BTH region, and with the data collected and reported by these sites, Chinese governments can better understand the air pollution situation at a certain place in real time. Essentially Chinese governments would know where it was being most polluted at the time and what kinds of pollutants casued this situation. The data are important to assist in developing cost-effective policies and solutions. The real-time data has also helped Chinese governments to provide public information on existing air quality. Through calculating the data on different air pollutants, Chinese governments could update real-time air quality index in places on a hourly basis via the official website to inform citizens to take necessary actions whenever they are out-door. Figure 2 below shows the user interface of air pollution management system.

[10] *Dan Zhang, Shan L Pan, Jiaxin, Yu., and Wenyuan, Liu. (2020) Orchestrating Big Data Analytics Capability for Sustainability: a Study of Air Pollution Management in China. Information & Management, http://dx.doi.org/10.1016/j.im.2019.103231*

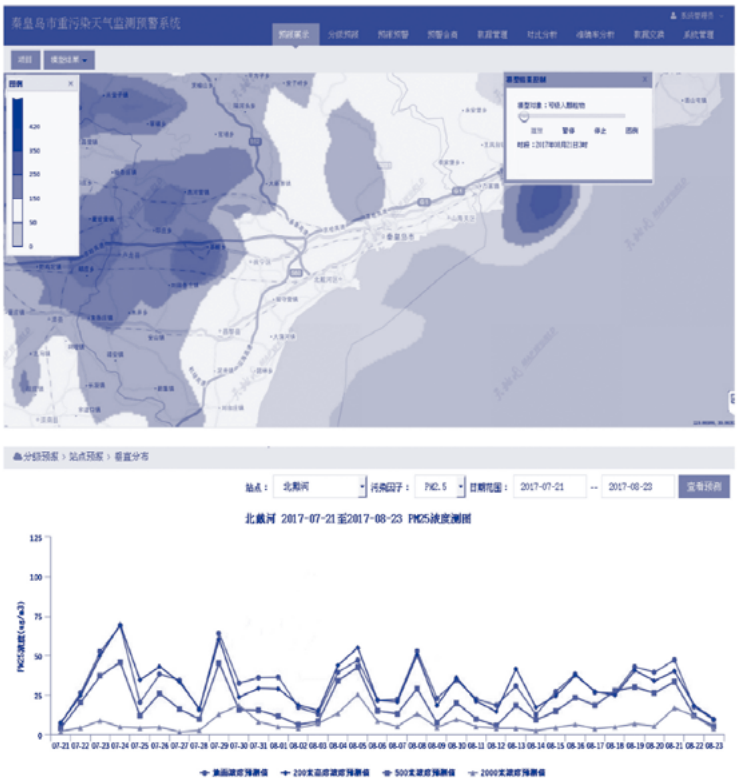

Figure 2: User Interface of Air Pollution Management System (Adapted from Zhang et al., 2020)

Having realised the great potential of big data in air pollution management, Chinese governments started to take further action. For example, the State Council of Chinese government recently made an announcement requiring construction of an air pollution management system that could provide early warning of heavy air pollution scenarios.

Both meteorological data (e.g., air temperature, wind direction, wind speed, and humidity) and pollution source data (e.g., the pollutant emission inventory of the pollution source), are needed for data analysis. To collect these data, the Provincial Governments have to coordinate with other departments of the local city government, such as the Meteorological Bureau and Environmental Protection Department, to receive relevant data in a timely manner. With IT support from the cooperating IT companies, gathered data are further processed by refining and restructuring them to meet the required data input format. By integrating the data from various sources into the air pollution management system for processing, the prediction results are presented as outputs for stakeholders.

The idea of using data analytics for identifying the pollutant dispersion pathways is derived from the process when the governments implemented the province-level air pollution management system, as required by Central government. At that time, they realised that the quality of data on air pollution was very significant for predictive accuracy. As there is a coverage limitation for the monitoring sites, higher data quality requires a more representative siting of the air quality monitoring systems, which can cover the majority of key sites prone to pollution. Due to the consideration of saving cost and increasing efficiency, it is essential to understand the pollutant dispersion pathways to optimise the regional monitoring network and forecast air quality more accurately. This could help to figure out how air pollution of a certain city influences its adjacent cities. The air pollutant dispersion pathways are expected to help Chinese governments understand this question, which would assist them in distinguishing the respective responsibility of the cities and help related cities take measures in advance of any upcoming heavy air pollution.

This case example suggests that management needs to focus on developing big data analytics capability to deeply unearth big data value so that it can assist decision making and solutioning for sustainability. By referring to data analytics, Chinese governments can select sources of data (e.g., sensor data, meteorological data, and pollutant source data), conduct data-focused actions (e.g., collecting, cleaning, integrating, processing, coordinating, and reusing data), and make data specific investments (e.g., investments in data infrastructire, data systems and data analytics) based on their realities and the data analytics capability they need to develop, so as to achieve specific sustainability goals.

Conclusion

Using digital innovation as enablers to achieve business sustainability objectives may turn out to be a competitive advantage for companies. This is not just a case of shifting bricks and mortar business models online, but reimagining ways of doing business and engaging with customers in a way that benefits wider society. Exploring and realising the potential of digital innovation to meet sustainability goals involves embracing a new mind-set that challenges companies to not only apply digital technologies to existing activities, but to ‘unlearn’ old way of doing things and relearn different ways of working. This is becoming key to maintaining efficiency and agility especially when establishing sustainable business practices is increasingly critical for companies to remain competitive.

For digital sustainability to work, companies need clarity and commitment from the leadership to drive sustainability initiatives with digital technologies; to inculcate the spirit of innovation by being open and always experimenting new ideas; and to nurture a digital mindset by creating the space in which innovation, partnerships and new business models can flourish. By conceiving entirely new ways in which the company operates and engages with its wider ecosystem, with digital innovation at its heart, digital technologies may transform the company and enable it to achieve sustainable business objectives and practices.

DATA ANALYTICS IN AUDIT

CHAPTER 2

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Key points for finance executives:

- Analytics, when designed and executed right, can greatly improve the quality, efficiency and value of financial statements audits.
- The results of the analytics are often visualised as graphs and charts, which are not only effective in displaying trends and identifying anomalies but also greatly improve the auditors' ability to be effective 'storytellers' in the boardroom.
- Audit firms must anticipate the potential pitfalls of analytics and develop a plan to address them.
- Analytics is just the start of technological innovations that will transform financial statements audits.

Background

The business landscape today has evolved significantly from two decades ago; organisations are rapidly and constantly embracing digital technologies to drive efficiencies in business operations and grow new markets.

For the audit profession, this calls for a renewed approach to auditing. Auditors today leverage advanced technologies and data analytics to process and analyse an organisation's data and processes. This shift to a smarter, technology-driven audit is a natural and required response to keep pace with the demands from the marketplace where management and audit committees not only expect a high quality audit but also unique insights and impactful recommendations into the operations and processes of a company.

What is Audit Analytics?

There are many varying definitions of data analytics but at its core, data analytics is the analysis of large amounts of data to uncover patterns and correlations to drive insights.

In financial statements audit where analytics is used to obtain audit evidence, data analytics is defined as "the science and art of discovering and analysing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter of an audit through analysis, modelling, and visualisation for the purpose of planning or performing the audit."[1]

Broadly speaking, there are four types of analytics, namely descriptive, diagnostic, predictive and prescriptive analytics[2]:

- **Descriptive Analytics**

  Descriptive analytics is the examination of data or content to answer the question "What happened?" and is often characterised by traditional business intelligence and visualisations such as pie charts, bar charts, line graphs, tables, or generated narratives.

[1] *Paragraph 6, Exploring the Growing Use of Technology in the Audit, with a Focus on Data Analytics, issued by the International Auditing and Assurance Standards Board (IAASB) in September 2016*

[2] *See Gartner IT Glossary: www.gartner.com/it-glossary/*

Descriptive analytics is often used during risk assessments to illustrate what had transpired during the period of analysis e.g. descriptive analytic such as a monthly sales trend analysis is effective in illustrating how sales has performed during the period of analysis.

- **Diagnostic Analytics**

Diagnostic analytics is a form of analytics which examines data or content to answer the question "Why did it happen?", and is characterised by techniques such as drill-down, data discovery, data mining and correlations.

Extending the example from above, if revenue was observed to have significantly decreased during a certain month, a common diagnostic would be to plot the monthly quantities and average selling price and check if either is a contributing factor to the lower revenue recorded.

- **Predictive Analytics**

Predictive analytics is a form of analytics which examines data or content to answer the question "What is going to happen?" or more precisely, "What is likely to happen?", and is characterised by techniques such as regression analysis, forecasting, multivariate statistics, pattern matching and predictive modelling.

A type of predictive analytics that is commonly used in financial statements audits is regression analysis. A regression model analysis models the relationship between an amount being tested (for e.g. sales during the current financial year period) and predicting variables (for e.g. cost of sales) over a series of time. A regression model is best used when a plausible and predictable relationship exists.

- **Prescriptive Analytics**

Prescriptive analytics is a form of advanced analytics which examines data or content to answer the question "What should be done?" or "What can we do to make XXXX happen?", and is characterised by techniques such as graph analysis, simulation, complex event processing, neural networks, recommendation engines, heuristics, and machine learning.

Prescriptive analytics is an analytics technique commonly used when addressing business challenges and making business decisions as it focuses on providing management with actionable insights and recommendations based on current scenario and available data. Due to the nature of the analytics, it is not commonly used in a financial statements audit.

The results of the analytics are very often visualised as graphs and charts. These visualisations are not only effective in displaying trends and identifying anomalies but also greatly improve the auditors' ability to be effective 'storytellers' in the boardroom. "A picture says a thousand words" – an effective visualisation makes it easier for management and board members to understand and appreciate the insights from the audit analytics.

When embedded in a financial statements audit, analytics enable auditors to examine larger populations and conduct more effective, focused testing. The key benefits from using analytics are summarised in Exhibit 1.

Exhibit 1: Key benefits from using analytics in audit

When to use what analytics?

Data analytics can be applied throughout the audit. In deciding which type of analytic would be more relevant, auditors should consider the objective of the analytic and how the analytic would address the specific audit assertions.

Certain analytics are simple and straightforward and can even be performed by the auditors themselves on a spreadsheet, depending on the size of the data. Where the use of analytics becomes more complex, firms have set up dedicated teams of analytics specialists to support the audits.

Some of the potential analytics that can be performed to support the substantive testing of certain account balances and risk areas are listed in Exhibit 2 below. The list is by no means exhaustive and there is a saying that 'the data is the limit' where analytics is concerned. There is a misconception that the use of analytics is suitable only for certain industries or account balances when, in fact, analytics can be performed so long as the relevant data is available in electronic form and the objective is clear.

Exhibit 2: Potential analytics in substantive testing

Phase of Audit	Risk Area	Analytics
Substantive	Sales	Three way match (Sales Orders – Delivery Orders – Sales Invoices)
	Project Revenue	Recalculation of Percentage-of-Completion Analysis of projects with abnormal margins Analysis of projects' time-to-completion
	Inventory	Net realisable value test Inventory obsolescence test Inventory costing (First-In-First-Out or Weighted Average Cost) Stockholding analysis to identify slow moving inventory

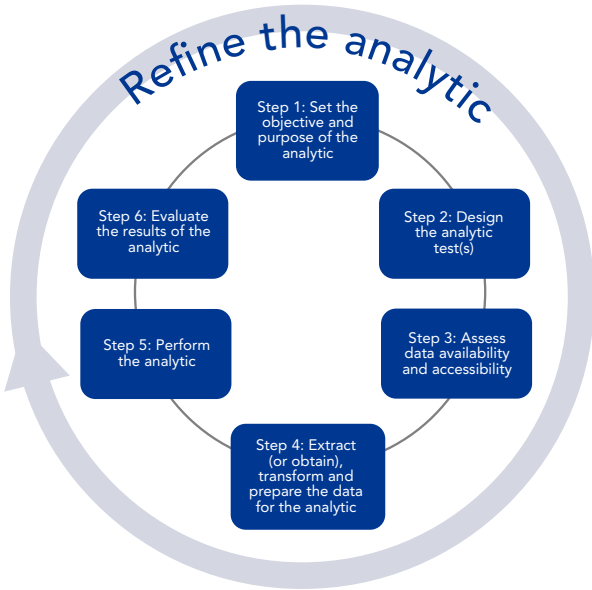
	Fixed Assets	Depreciation recalculation Asset disposals before end of defined useful life Asset-under-construction aging profile
	Payroll	Payments to new hires before first day of service Payments to resignees after last day of service Monthly payroll and headcount analysis
	Management Override of Controls	Journal entry testing by subjecting full population of journals against pre-determined test parameters: • Entries with unusual relationships (e.g. Cr Revenue Dr Prepayments) • Entries posted by non-finance users • Entries posted in the closing period with no descriptions

How is analytics applied in the audit process?

The basic steps in applying analytics in the audit process are illustrated in Exhibit 3 below.

When designing and building a new analytic, auditors may spend some time setting up the data acquisition and transformation process. The initial results from the analytic may prompt auditors to ask new questions and thus, may be informed of new data points that can be used to further refine the analytic. As such, the use of analytics in a financial statements audit is often an iterative process and depending on the specific circumstances, auditors may perform certain steps and procedures concurrently or in a different order from the steps set out below.

Exhibit 3: Basic steps in applying analytics in an audit



How does analytics improve the traditional audit process?

A well-designed analytics tool can greatly improve the overall quality of an audit. By using analytics, auditors can obtain a better understanding of the entity's processes and focus on items of greater audit interest.

Risk Assessment

In risk assessment, analytics can profile and disaggregate whole populations to provide fact-based evidence that supports the auditor's risk assessment. Audits can be more risk-focused as auditors focus their attention on higher-risk areas and items with unusual characteristics.

Case Study – Disaggregation of expense accounts

In the audit of an early childhood education institute, the auditor assessed and determined that the operating expenditure account to be of a material balance and proceeded to design the appropriate audit procedures to address the risks of material misstatements on the account.

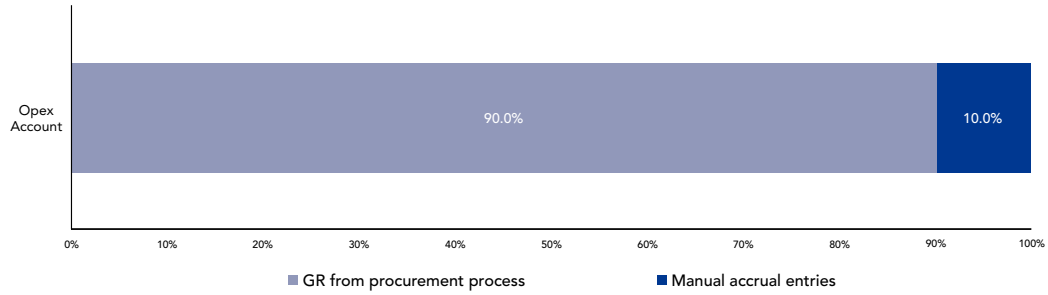
The procurement of the goods and services is tracked within the entity's system in the procurement module and follows the process in Exhibit 4. The auditor also noted that corresponding liability and expense entries are recorded in the financial module of the entity when goods or service receipt is performed in the procurement module.

Exhibit 4: Procurement process within system

Based on this understanding, the auditor expected all, if not most, of the expenses recorded to go through the standard procurement process above. An analytics tool was designed to disaggregate the operating expenditure account in order to identify expenses recorded that could not be traced back to a goods receipt from the standard procurement process.

The result of the analytic shows that 90 per cent of the total operating expenses were recorded from a goods receipt performed in the standard procurement process and the remaining could not be traced back to a goods receipt (Exhibit 5).

Exhibit 5: Disaggregation of operating expenses



The auditor understood that the expenses that could not be traced back to a goods receipt were manual accrual entries posted by the finance team for the month end closing. The accrual entries pertained to goods receipts that had not been posted in time for the month end closing. The accrual entries were prepared by the finance accountant and reviewed and approved by the finance manager.

Based on the results of the analytics and the subsequent understanding obtained, the auditor decided to adjust the risk assessment of the operating expenses to reflect a higher audit focus on this particular group of accrual entries. A well-designed analytics, such as in this case, can provide fact-based evidence to support the auditor's risk assessment and also enables the auditor to focus the audit efforts on items of greater interest.

Substantive Testing

In substantive testing, the procedure performed by the analytics need not be fundamentally different from the conventional procedures that are performed by auditors on a sampling basis. Instead, the use of analytics enables auditors to apply the procedure across the entire population and incorporate additional information to supplement and improve the analysis.

Case Study – Net Realizable Value ("NRV") of Inventory

Part 1: NRV test – analysing latest sales price in the year

The entity is in the retail/trading industry and sells high volume of individually low value household items.

In prior years, the auditor had taken the traditional approach of performing the test procedure on a sampling basis; the auditor selected random samples of inventory held at year end and compared the unit cost of the inventory item to its last unit sales price during the year. For the current year, the auditor decided to use data analytics to perform NRV testing on the entire inventory population to check that the inventories are valued at lower of cost or NRV.

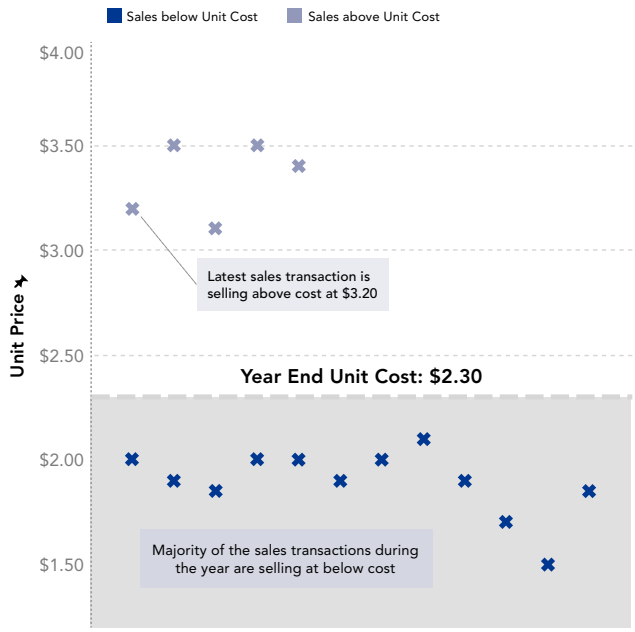
The auditor designed an analytics procedure to compare the unit cost of each inventory item against the unit sales price of the item's latest sales transaction. The analytics will be performed on 100 per cent of the inventory items at year end instead of on a sample basis, thus giving greater assurance and hence, increasing the quality of the audit.

Part 2: Extension of NRV test – analysing all sales prices in the year

Based on the company's pricing policy, the auditor does not expect any inventory item to be sold below cost at any time during the year. For all inventory items held at year end, the auditor decided to extend the analysis by examining all sales transactions in the year to identify any transactions where the sales price was below cost.

The analytics identified there were sales transactions of the inventory item 101A where the sales price was lower than the inventory's unit cost at year end (Exhibit 6).

Exhibit 6: Inventory Item 101A: Analysis of sales prices against unit cost



The auditor noted that for inventory item 101A, the latest sales price was higher than unit cost of $2.30 at year end and thus did not give an indication of potential NRV issue under the testing performed in Part 1. However, the result of the analytics performed in Part 2 revealed that there were a number of sales transactions during the year that were selling below cost. The auditor subsequently enquired with management on these sales transactions to assess if the valuation of this inventory item had a risk of material misstatement.

By using analytics, the auditor was able to perform the NRV test (Part 1) in a more effective manner by electronically replicating the checks performed manually in prior year. The quality of the audit is also elevated as the entire population of the inventory balance at year end was subjected to the NRV test.

By extending the analytics and examining all the sales transactions in the year (Part 2), the auditor was able to identify potential NRV issues which may not have been detected using the traditional sampling approach. With analytics, the audit testing was more effective and the auditor was able to obtain a higher level of assurance by checking that inventory items were not sold at a price lower than cost, at any point during the year.

Substantive Testing – Incorporating Third Party Evidence

By incorporating third party information like bank reports or market data, analytics can greatly improve the quality of audit evidence.

Case Study – POS to Proof of Subsequent Receipts

The entity is in the Fast Moving Consumer Goods (FMCG) industry with 10 retail stores. The retail stores use POS machine to record each transaction. On average, each store records approximately 5000 transactions each day.

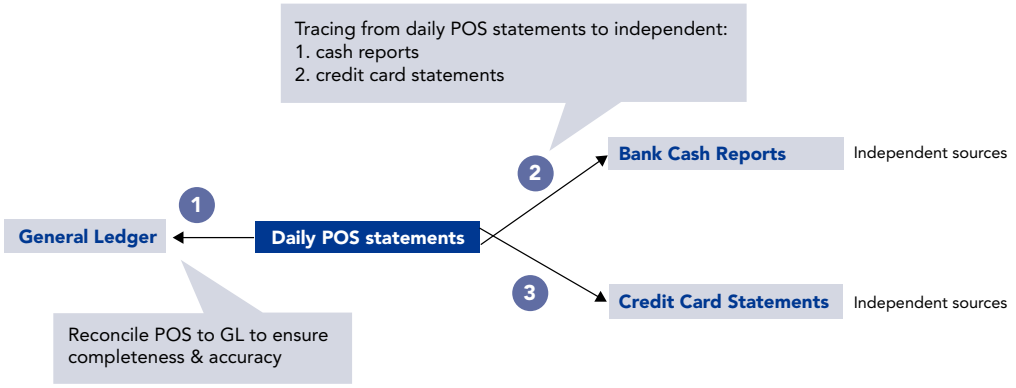
Customers pay for purchases typically through the following methods:

- Cash
  For cash sales, the cash receipts are banked in daily. Through a direct bank feed, each store will receive a daily cash report from the bank.

- Credit Card
  Through a direct bank feed, a credit card statement per store is provided by the bank on a monthly basis. The monthly report contains details of transactions of each store on a daily basis during the month.

The auditor decided an analytic that traces the daily transactions on the POS statements to the third-party bank feed information which will provide strong and persuasive audit evidence for the occurrence of the sales. (Exhibit 7)

Exhibit 7: Analytics procedure tracing POS to proof of subsequent receipts



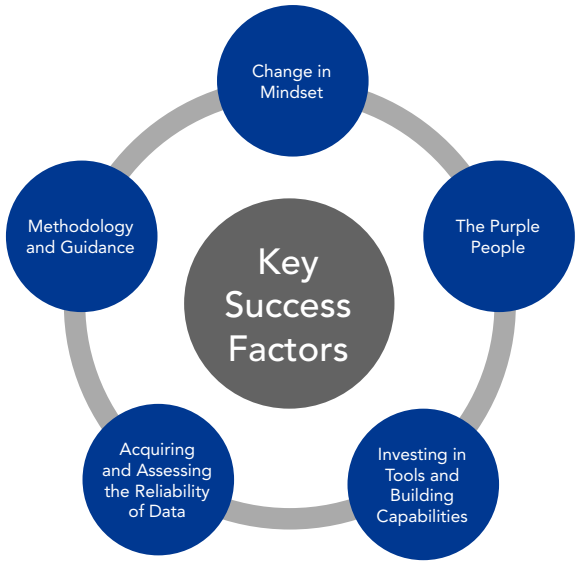
The results of the analytics show that 100 per cent of the POS transactions could be validated and traced to matching amounts in the bank reports.

The analytics tool provided persuasive audit evidence using independent third-party data to support the audit and was a more efficient and effective tool that allowed the auditors to examine 100 per cent of the sales transactions.

Key success factors in deploying analytics in audit

Marrying analytics with audit is not straight forward. The success of deploying analytics in audit is dependent on not merely how fast firms adopt enabling technologies, but also how well the firm can upskill and change the mindset of their professionals. Some of the key success factors in deploying analytics in audits are set out in Exhibit 8.

Exhibit 8: Key Success Factors



a. Change in Mindset

The most basic, yet integral success factor to deploying analytics in audit, is none other than mindset change within the profession. Audits have been done on a sampling basis since auditing began. Telling the practitioners that they can now analyse 100 per cent of an entity's data does cause some trepidation as they are treading into an unknown territory. The importance of having the right tone from the top, coupled with the guidance and support from the standard setters, professional bodies and regulators in embracing this new development cannot be emphasised enough to change the mindset and break through the scepticism that the auditors may have over the use of data analytics.

b. The Purple People

The term 'purple people' was coined to refer to people who have a mix of both business and technology skills as shown in (Exhibit 9). Audit firms are increasingly recognising the importance of 'purple people' in deploying analytics and innovation in the audit.

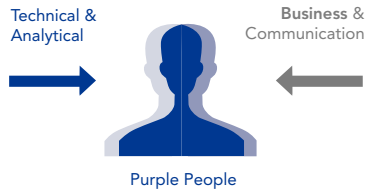
While it is not necessary for auditors to become full-fledge programmers because the more complex analytics could still be run by a group of specialists, they need to be conversant with information process flows and data, and be able to effectively articulate the design of analytic tests and how the tests fulfil the audit objectives.

In the tertiary education institutes, topics like data analytics, basic data science and visualisations have been introduced into the curriculum so new graduates are knowledgeable in those areas when they enter the workforce. The bigger challenge is for experienced existing professionals who have been performing sampling for a large part of their career to adapt and learn these new skills. Audit firms need to support their staff by developing learning content or directing them to relevant training.

Exhibit 9: The Purple People

Purple People

Being able to ask the right business questions, interrogate and model data to answer them, and then present the insights in a compelling way are important skills to have, either in a single individual or as complementary skills within the analytics team. "Red" employees bring critical thinking, problem-solving and maths-les skillsets, while "blue" people's strengths lie in creativity, soft skills, and ability to visualise and draw business insights from data.



c. Investing in Tools and Building Capabilities

For the larger audit firms, investment in in-house capabilities is well underway and analytics is already an integral component in their audit offerings. In contrast, some Small and Medium Practices ("SMPs") may be hesitant to make the necessary technology and human investments due to cost considerations and uncertainty of returns.

Instead of developing in-house capabilities, it may be more cost effective for SMPs to evaluate off-the-shelf solutions currently on offer. Concurrently, Excel can be a powerful tool for analytics. Audit firms can build data models synthesising large amounts of data and perform powerful data analysis on that data in Excel itself, all at a relatively low or even no incremental cost at all.

Even after acquiring the right tools, there is too often a tendency for auditors to be overconfident in the use of analytics tools and unquestioningly rely on the outputs of the analytics. The use of technological tools does not remove the auditor's responsibility to question and professionally evaluate if the tools are operating effectively as planned. Auditors should understand what a tool can do, and cannot do. Auditors should also be very clear on the key assumptions, inputs and logics behind the tool and analytic model in order to properly evaluate if the tool is appropriate for the planned audit objective.

d. Acquiring and Assessing the Reliability of Data

The result of the analytics is only as good as the underlying data. After the objective of an analytic is determined, the next questions to ask are 'What data do I need to perform this analytic? How do I access and extract that data?'.

In many cases, the data used for the analytic can be extracted and provided by the audit client themselves. In such cases, the client may generate standard reports from the system or enlist the assistance of their IT department to generate the data from the backend database.

In other cases, such as when the data is too voluminous, auditors may be called upon to extract the data themselves. Information systems used by companies can be complicated and auditors may find themselves having to involve specialist staff to advise and facilitate the data extraction. In the market, software vendors are also offering solutions dedicated to data extraction, standardisation and transformation.

Regardless of whether the data is provided by the audit client or extracted by the auditors themselves, auditors are required to assess the relevance and reliability of the data. Assessing the relevance and reliability of the information to be used in an audit is not a new concept[3] but becomes exponentially important when analytics is performed on 100 per cent of the data.

Audit firms will have existing methods of testing and ascertaining the quality of data used in the audit, which may involve testing of a sample of the data. Those methods should be reviewed – are those methods still relevant and effective in detecting data quality issues in thousands or even millions of data points? Or is there a need to develop a more robust framework with procedures specifically designed to address the quality of big data used in audits.

[3] *SSA 500 Audit Evidence states that the auditor shall consider the relevance and reliability of the information to be used as audit evidence and this remains unchanged in the face of analytics.*

Some of the questions that auditors should consider include:

- How was the data extracted? What parameters or filters were applied during the extraction?
- How can we ensure that the data is accurate and complete?
- Which are the critical fields required for the audit analytics tool? What gaps are detected in these fields?
- What could be the reasons for the data quality issues detected?
- Are there any deficiencies in general IT controls or specific application controls? How would this impact the integrity of the information provided by entity that is used in the analytics?

While investigating and resolving data quality issues, auditors may even detect irregularities in system control processes, for example inappropriate personnel having access and modifying master data. A data quality issue may just be an isolated incident but at other times, it could be evidence of significant deficiencies in the systems and processes of the company.

e. Methodology and Guidance

Rather than replacing the audit procedures, analytics are often performed as a supplement to audit evidence gathered through traditional audit procedures. The hesitation probably stems from the fact that the current auditing standards do not provide explicit guidance on the use of analytics in audits, particularly the unprecedented problem where hundreds or even thousands of outliers are identified after performing an analytic. Not all outliers will turn out to be exceptions but where and how to start investigating, and the extent of documentation required, is an area that auditors need guidance in.

Standard setters internationally have recognised the pressing need to update current auditing standards to provide more guidance on the use of such tools and techniques. In December 2019, IAASB released ISA 315 (Revised)[4] where one of the key updates was the inclusion and explicit reference to the use of automated tools and techniques (including data analytics) in risk assessment procedures. The IAASB has also released several non-authoritative guidance to address some of the frequently asked questions when using automated tools and techniques in audits[5].

As can be expected, the development of new authoritative material will take time and practitioners will look internally for firm specific guidance on applying analytics in audits. To drive adoption in analytics, audit firms need to issue clear directives and provide practical examples for their audit professionals. Audit firms should also remind their practitioners to fall back on the core principles of the current auditing standards and interpret them with fresh perspectives considering the evolving backdrop of technological innovation and analytics.

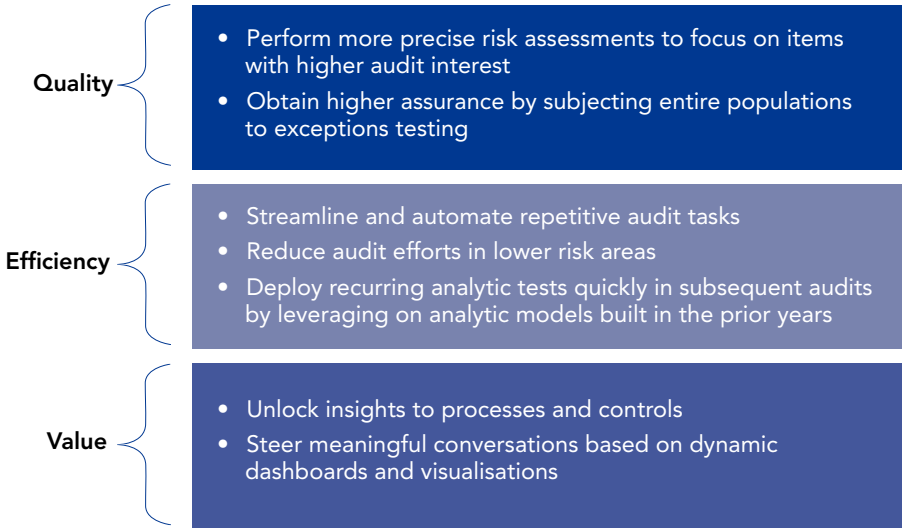
[4] *ISA 315 (Revised), Identifying and Assessing the Risks of Material Misstatement.*

[5] *https://www.ifac.org/system/files/publications/files/IAASB-Automated-Tools-Techniques-FAQ.pdf*
https://www.ifac.org/system/files/publications/files/IAASB-Technology-FAQ-Automated-Tools-Techniques.pdf
https://www.ifac.org/system/files/publications/files/IAASB-FAQ-Automated-Tools-Techniques.pdf

Conclusion

Analytics, when designed and executed right, can improve the quality, efficiency and value of financial statements audits (Exhibit 10). Whilst it is imperative for audit firms to start on their analytics journey (if they had not already), it is equally important for firms to anticipate the potential pitfalls and develop a plan to address them.

Exhibit 10: Quality, Efficiency and Value of audit analytics



While our discussion is mostly focused on analytics, audit firms must recognise that analytics is just the onset of the technological innovations that will transform the face of financial statements audits. There are rapid advances in technologies such as automated tools, artificial intelligence and the Internet of Things (IoT) and these technologies will no doubt further change the way audits are executed and delivered. The audit of the future will look dramatically different from the audit we are used to, and firms must be ready to embrace and navigate this unchartered terrain.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN DIGITAL FINANCE

CHAPTER 3

Greg Unsworth
Risk Assurance and Digital Business Leader

PwC Singapore

Key points for finance executives:

- The journey to full adoption of Artificial Intelligence (AI) and Machine Learning (ML) within the finance function is in its early stage of development.
- AI and predictive analytics can enhance the value, effectiveness and relevance of finance teams, by allowing them to devote more time to analysing and interpreting data to support strategic decision making and the execution of business plans.
- The largest perceived barrier to wider adoption of AI is cost. Insufficient infrastructure and poor data quality are also identified as priority areas of concern.
- Those willing to invest the time and effort now to upgrade their skills and take a lead to embrace the potential of AI technologies will benefit the most.

As COVID-19 set the world upside down, we saw a massive surge in the use of digital channels to work remotely, to access healthcare and other needs, to sell, shop and practically reshape every aspect of life.

The pandemic-induced digital acceleration has propelled increased AI adoption, advanced analytics, and automation. This has helped businesses enhance decision making and productivity, aside from other activities such as product innovation, contactless selling, enhanced customer service and supply chain effectiveness, to stay relevant in the new world. As this trend progresses and we look to the future, it's quite clear that AI enabled businesses have the potential to be the biggest technology transformation driver for the next five years and beyond for many organisations.

For accounting and finance professionals, there are undoubtedly many benefits of adopting AI and ML, from automating tedious, manual workflows, to enhancing the value of the finance function through predictive analytics, analysing insights and being a strategic advisor to the business. However, there are some challenges in execution of AI initiatives. Proper governance and controls should be in place to ensure that AI applications are free from unintended bias and that they are deployed ethically and transparently. There will also be the need to continually re-skill and upskill for finance professionals.

Whilst the journey to full adoption of AI and ML within the finance function has begun, it is still at an early stage of development. For accounting and finance professionals, there is a window of opportunity to take bold steps now. It will enable them to lead the evolution with AI and enhance the relevance and effectiveness of the finance function for the future. According to PwC's Finance Effectiveness Benchmarking Report 2019[1], 61 per cent of finance leaders believe that finance functions could become more effective with improved technology.

In this article, we explore the opportunities and challenges associated with AI adoption and highlight the key considerations for finance and accounting professionals going forward.

[1] *https://www.pwc.com/us/en/services/consulting/finance/finance-effectiveness-benchmark-study.html*

Background and context

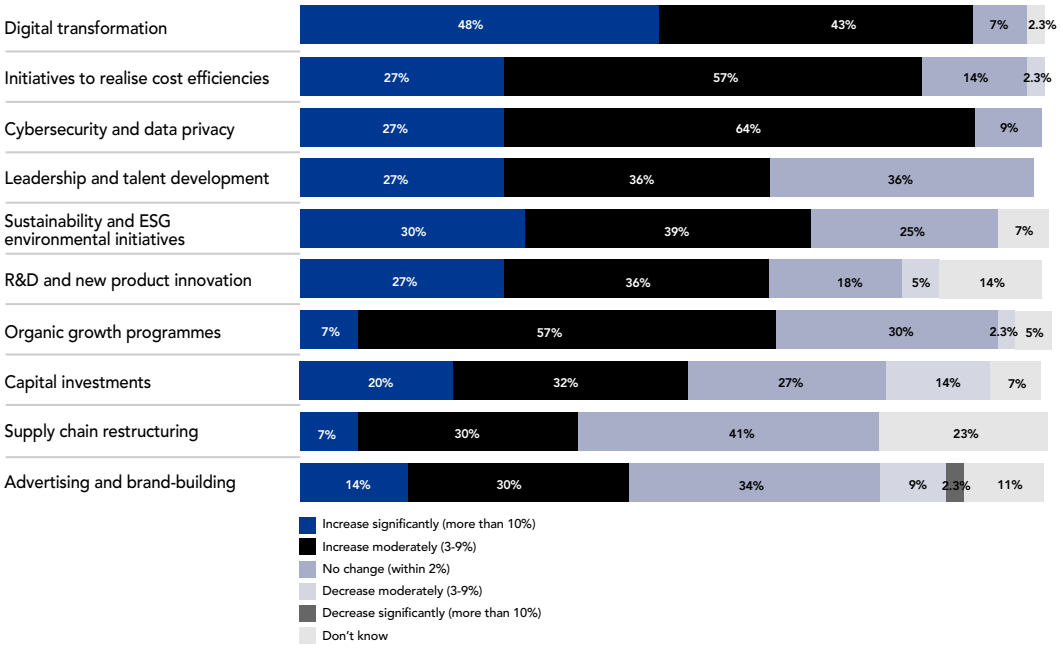
As the world of business shifts from survival to resilience mode and business confidence gradually increases, digital transformation will continue to be a key priority for the majority of business leaders, particularly among small and medium-sized businesses.

According to PwC's 24th Annual Global CEO survey, 91 per cent of Singapore CEOs are prioritising investments in digital transformation over the next three years (Exhibit 1). At the same time, business operations and processes have become more virtual.

With increased remote workforce models, there are increasing concerns over cyber threats and misinformation with 40 per cent of CEOs in Asia Pacific listing cyber threats as the next top threat after pandemics and health crises. It's no wonder that 91 per cent of Singapore CEOs are charting out longer term investment plans to set guard rails in cyberspace for securing their organisation.

Exhibit 1: Top 10 areas in which Singapore businesses prioritising investments

Q. How do you plan to change your long-term investments in the following areas over the next three years, as a result of the COVID-19 crisis?



Source: PwC's 24th Annual Global CEO Survey

There is a huge potential opportunity in AI technology, with the global market value forecasted to grow rapidly in the coming years, reaching up to US$126 billion by 2025[2]. According to PwC's research[3] prior to the pandemic, while 85 per cent of CEOs believed that AI will significantly change the way they do business in the next five years, the reality was that nearly half (44 per cent) of the organisations in Singapore were not making any use of AI. Only about 8 per cent of Singapore business leaders viewed themselves as highly competitive in terms of AI usage. Larger organisations (54 per cent) globally have had a higher AI adoption rate, reflecting the level of investment available for AI technologies. From a regional perspective, Asia Pacific (APAC) has been ahead in the pack, with almost 61 per cent reporting that half or more of their workload was supported by AI[4].

The digital transformation journey for accounting and finance professionals

For the accounting and finance profession, the AI journey is under way, with many recognising the need to embrace new technologies. Finance functions will increasingly leverage data, automate and optimise business processes and use AI and predictive analytics to a greater extent to enhance the value, effectiveness and relevance of their teams in the future. The importance of AI and ML will also likely increase as business needs continue to become more complex.

In the accounting context, it is already having a crucial impact on the traditional functions of recording and reconciliation, as many finance professionals now focus on the value of effective data analysis and trend insights.

The next stage for many finance teams will be to enhance decision making effectiveness through greater use of ML and AI adoption. PwC sees this trend increasing for accountants both in corporate roles and those in public practice to respond to evolving client needs.

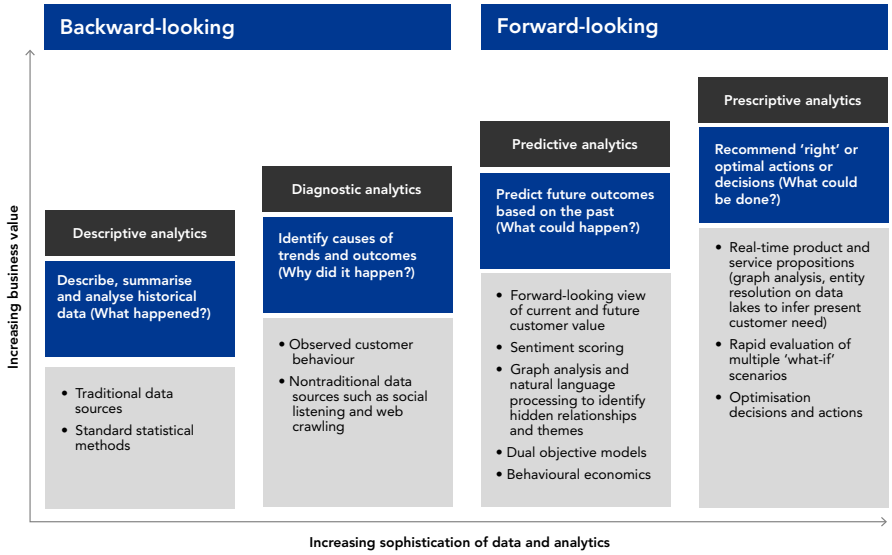
The repetitive nature of many accountancy tasks means they are ideally placed for new and enhanced practices enabled by automation and AI. It is expected that greater use of intelligence tools and technologies will help move the profession from traditional "bookkeeping" functions to delivering forward looking insights to a much greater extent while driving strategic decision making (Exhibit 2). Furthermore, ML models applied to data can also help reduce fraud, enhance trust and increase the effectiveness of an organisation's compliance programmes.

[2] *https://www.statista.com/statistics/607716/worldwide-artificial-intelligence-market-revenues/*

[3] *https://www.pwc.com/sg/en/publications/ceo-survey-2020.html*

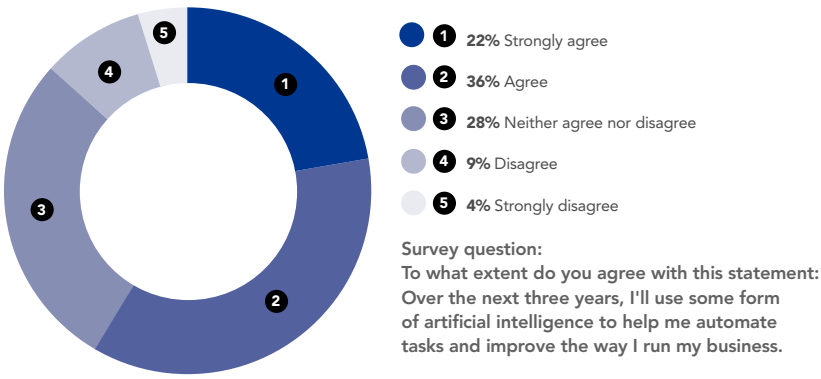
[4] *http://www.asbasupervision.com/en/bibl/xii-recommended-readings-COVID-19/2457-the-road-ahead-artificial-intelligence-and-the-future-of-financial-services-1/file*

Exhibit 2: The path to digitising the finance function



Importantly, AI is a great people enabler. It can create the potential to do more with the resources available to enhance productivity, by automating administrative tasks, such as gathering, sorting and visualising important data in a way that helps the business run more efficiently. This will allow accountants to devote more time and energy on analysing and interpreting the data to support strategic decision making and drive the execution of business plans. Many professionals are excited by the benefits that AI can offer. In fact, according to Sage's "The Practice of Now" report[5], more than half (58 per cent) of accountants surveyed in the United States strongly agree or agree that AI will help improve their organisations in the future (Exhibit 3).

Exhibit 3: Artificial intelligence will help automate tasks and improve my firm



Source: Sage's The Practice of Now Report

[5] *https://img06.en25.com/Web/SageGlobalInstance/%7bcad5bcbe-4964-41b5-94b4-e2bf3c9c2666%7d_CL_ACS_US_PDF_PracticeofNow2019_COM_TOP_GNRC.pdf*

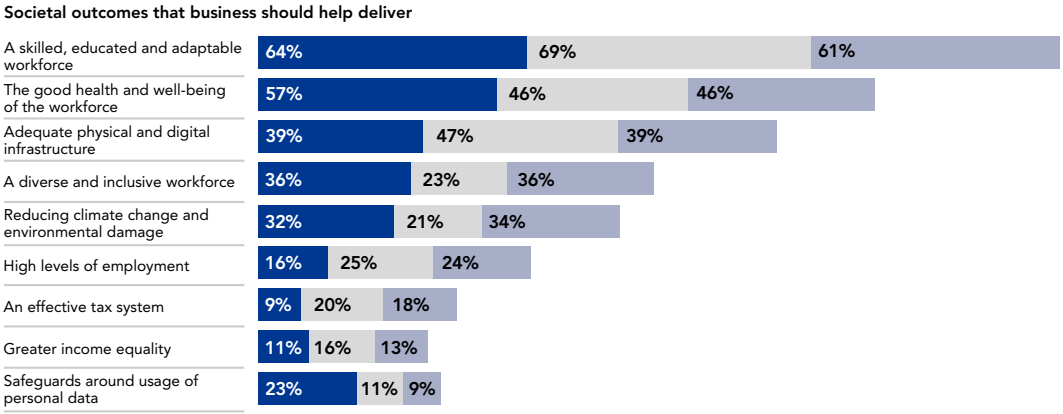
The transformative nature of these technologies will potentially be profound. For example, in the financial services sector in particular, many manual tasks that were predominantly offshored in recent decades are now often being automated onshore. This trend will lead to some restructuring of workforce models, with finance teams broadening and developing their skills and performing higher value functions beyond repetitive processing and recording.

While there is a broad acknowledgement that this will necessitate relevant employee upskilling and company-wide cultural shifts, the degree to which this has already taken place varies. Based on the recent Economist report[6], APAC leads the field regionally, while investment banks are most advanced in their implementation of training schemes. In PwC's recent CEO survey, the majority of Singapore CEOs (64 per cent)[7] put the creation of a skilled, educated and adaptable workforce on top of the list when asked to prioritise societal outcomes that businesses should help deliver (Exhibit 4).

Furthermore, there are real employee concerns and anxiety around machines taking away people's jobs. As it was revealed in **PwC's Hopes and Fears Survey 2021** that 65 per cent of Singaporean adults are worried about automation putting jobs at risk, as compared to 51 per cent in 2019. This is where broad based upskilling at a societal, industry and individual level will be crucial to enable the workforce of the future.

Exhibit 4: Top societal outcomes Singapore businesses are prioritising

Q. Which three of these outcomes do you think should be priorities for business to help deliver in the country / territory in which you are based?



Source: PwC's 24th Annual Global CEO survey

[6] *http://www.asbasupervision.com/en/bibl/xii-recommended-readings-COVID-19/2457-the-road-ahead-artificial-intelligence-and-the-future-of-financial-services-1/file*

[7] *https://www.pwc.com/sg/en/publications/ceo-survey-2021.html*

Benefits of AI and ML

For finance function

For many companies, their AI journey starts with the development of robotic process automation (RPA), based on the notion of software robots automating routine tasks. Once programmed, RPA can run unattended to automate large volumes of specific accounting processes that are structured and repetitive, such as data entry and reconciliation activities. When deployed at scale, RPA has the potential to act like a virtual workforce and position the accounting profession to provide higher value functions and activities.

Beyond automation, AI technologies can further be used to analyse large quantities of data at speed and at scale. It has the ability to detect anomalies in the system and optimise workflow. Finance professionals can use **AI to assist with business decision-making**, based on actionable insights derived from customer demographics, past transactional data and external factors, all in real-time.

By implementing automated anti-fraud and finance management systems, practices can also **significantly improve compliance procedures and protect both their own and clients' finances**. In this way, AI technology and accountants can work together to provide a more predictive, strategic function — using the available data to pick up on potential issues before they have an impact on the business. This will enable accountants to not just look back but look forward with more clarity and impact than ever before.

As we move forward, we see three clear areas of AI application for the accountancy and finance profession: invisible accounting, continuous audit, and active insight.

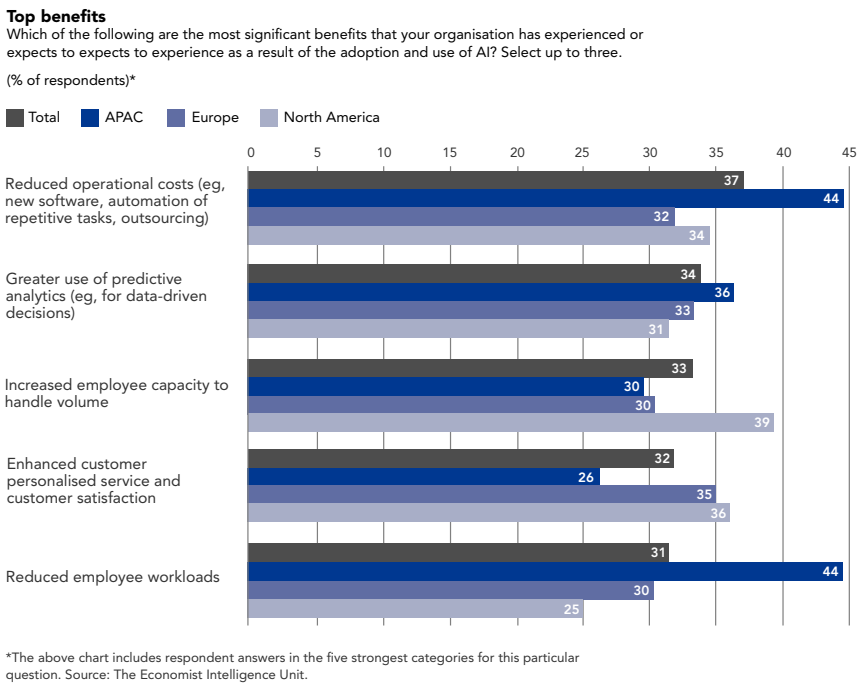
AI will provide businesses with the ability to capture business activity in real time, perform continuous reconciliation and make adjustments such as accruals throughout the month. This will also help reduce the burden at the end of the period. **Invisible accounting** refers to the development of processes with no human intervention through the use of AI to drive automation, decision making, execute processes and drive significant efficiencies, all while freeing up the workload of finance professionals.

AI can also facilitate effective **continuous audit**, significantly reducing risk of financial fraud and minimise accounting errors, often caused by human interaction. The rise of online banking for instance has brought a host of advantages, but it has also created new avenues for financial crime, specifically around fraud. The chances of an unauthorised payments slipping through the net grows as the volume of data increases. That has made the accountant's compliance task much harder to complete without the best of technology available at their fingertips to deploy. There are already many applications of AI in practice that are helping organisations address these challenges real time.

Active insights can also play a key feature in the deployment of AI by finance teams. Companies can use predictive monitoring to perform cash flow forecasting for instance, predicting when the business might run out of money and take actions to protect against the situation ahead of time. They can identify when a customer might be about to leave and look at how to support customer service teams to take steps to encourage "at risk" customers to renew their service contracts. This all means that accountants will be able to help organisations respond to financial and business challenges before they become acute, adjusting expenditure or processes as required and help to ensure better business outcomes more generally with a potentially more expansive role in supporting their organisations.

In a research done by The Economist Intelligence Unit[8], the **APAC respondents from financial services organisations considered improved risk management – such as fraud prevention, as the key benefit of AI**. Reduced operational costs and reduced employee workloads were the other two benefits perceived by nearly half (44 per cent) of the region's respondents. Around a third of the APAC respondents indicated that AI helps facilitate data-driven decisions through greater use of predictive analytics and increasing capacity to handle larger volumes of work (Exhibit 5).

Exhibit 5: Benefits of AI in Financial Services Sector: Survey report



*The above chart includes respondent answers in the five strongest categories for this particular question. Source: The Economist Intelligence Unit.

Beyond the finance function

Going beyond pure finance functions, as AI applications integrate data with wider business information flows, accountants will also be able to broaden their predictive analysis capability beyond pure financial planning to other areas of valuable support for the business, including:

- **Customer and stakeholder satisfaction:** As businesses use robots and automated data analysis through social networks, websites, email exchanges and other data sources, it is in the integration of the data from various sources that will create the actionable insights for the business.
- **Security:** AI deployment in finance can also allow businesses to find breaches in security systems to be detected as well as to explore solutions. It will be able to analyse documentation for account registration and detect issues within accounts for instance.
- **Risk management:** It is difficult to overestimate the potential impact and benefits of AI when it comes to risk management. Enormous processing power allows vast amounts of data to be handled in a short time, and cognitive computing can help to manage both structured and unstructured data, a task that would take far too much time for humans to do effectively.

[8] *http://www.asbasupervision.com/en/bibl/xii-recommended-readings-covid-19/2457-the-road-ahead-artificial-intelligence-and-the-future-of-financial-services-1/file*

- **Fraud prevention:** For a number of years now, AI has been very successful in battling financial fraud — and this will only become enhanced as AI becomes more widely adopted. Fraud detection systems can analyse clients' behaviour, location, and buying habits and trigger a security mechanism when something seems out of the ordinary and contradicts established spending patterns for instance.
- **Process automation:** Forward-thinking industry leaders are looking to RPA when they want to cut operational costs and boost productivity. Intelligent character recognition makes it possible to automate a variety of mundane, time-consuming tasks. AI-enabled software can also be used to verify data and generate reports automatically according to the given parameters, as well as review documents, and extract meaningful insights from the data being processed.

The way forward

There is still much more education to be undertaken and the journey to fully fledged AI adoption is still in its infancy for many organisations. The largest perceived barrier to wider adoption of AI is cost. Insufficient infrastructure and poor data quality are also identified as priority areas of concern.

As technologies develop, AI and ML will become more technically-smart and adapted to business processes. They are complicated technologies that only start evolving as they are used more extensively, generating ever increasing benefits as adoption increases. It will be a continuous journey for finance teams, and in the years to come, embracing the possibilities of AI will be essential for any organisation driving real progress and leadership in finance functions.

Finance and accounting professionals have a unique opportunity to "step up" and be at the centre of driving this change for many organisations. The benefits of AI adoption ultimately lead back to people – taking the strain off them, or at the very least allowing them to do more with the same workload in the next phase of technology adoption. It is also the people, not technology that poses a key challenge for organisations. A well thought through change programme, supported and driven from the top, is critical to transform organisations and ensure responsible adoption of AI.

- **Develop a plan for enhanced AI usage**

In developing a plan for enhanced use of AI by any finance function, here are 3 key steps to consider and adopt from the outset:

1) Data is the fuel for AI – develop a robust strategy for data management and align this with the corporate data strategy
2) Develop digitally-fit finance teams by
    a) identifying the knowledge and capabilities required;
    b) having the right leadership skills and capabilities to strategically advise the teams on the opportunities for deployment of AI; and
    c) changing the finance function's processes, tools and systems to be more data driven and digitally enabled for a grasp on today's needs and a view on the ability to scale for the future
3) Create the governance and trust framework and controls and ensure data security practices are robust

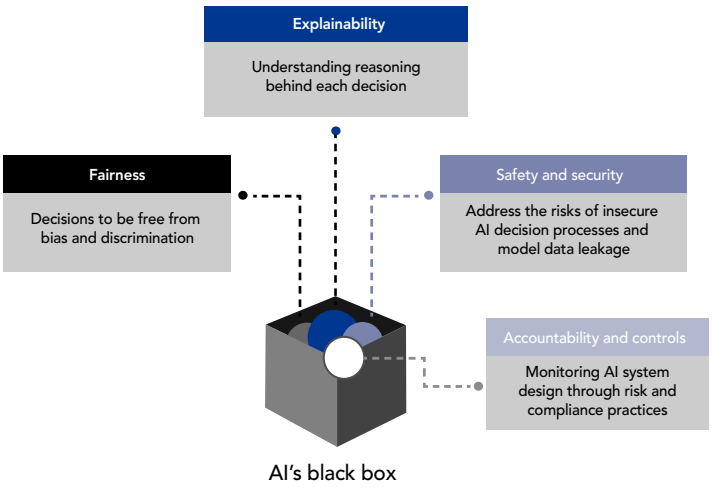
- **Build the required skills**

Besides ensuring employee upskilling in the technical skills required, organisations will also need to ensure the skills are complemented by deep understanding of the insights and data required for in the business context. From technical accounting expertise to collaborating and partnering with other parts of the organisation to drive the right meaning from the AI models. For example, accountants may need to be involved in training or testing models, or auditing algorithms which may require deeper knowledge of ML techniques.

- **Create governance structure and trust framework**

In creating the governance and trust framework, controls and practices will need to be put in place to ensure that the algorithms and data analysed are free of bias and result in ethical, responsible and transparent decision making. The deployment of responsible AI will require four key attributes to be addressed – fairness; explainability; safety and security and; accountability and controls (Exhibit 6).

Exhibit 6: Responsible AI - Fundamental framework



- **Keep focus on 'Responsible AI'**

As AI adoption accelerates and its algorithms process larger amounts of data over time, the machine decision making process becomes smarter and more effective, leading to better outcomes. However, there needs to be safeguards in place in the event that AI programmes do "go wrong" especially if the criteria for algorithms are not well-defined or if data used for processing is inaccurate or incomplete.

Accordingly, for any organisation embracing the adoption of AI, there is a significant need to address key risk areas and:

- maintain effective governance structures, processes and procedures,
- establish controls to manage the risk of unintended human bias and logic errors in AI applications,
- regularly monitor and control to manage the risk of AI outcomes causing harm, or undesirable unintended outcomes,

- ensure effective data protection, quality and effectiveness and adherence to new evolving regulatory requirements, and
- keep an effective check on the performance and overall cost/benefit analysis of AI programmes.

The benefits of greater AI adoption are becoming more widely recognised across different industry sectors, enabling improved productivity and better predictive analytics and business practices. However, as more organisations deploy organisation-wide AI programmes, there is a need to ensure that the risks are being well-managed, and that AI programmes are delivering their intended outcomes.

Important questions for any organisation to address in ensuring responsible use of AI include the following:

- Is the AI initiative well-defined, governed and monitored against expected business outcomes?
- Are all ethical, moral and safety considerations fully addressed in any responsible AI programme?
- Are criteria well-defined and algorithms developed effectively?
- Are the relevant criteria appropriately tailored for the business?
- Are algorithms subject to continuing review and monitoring for their continued relevance and effectiveness?
- Is data subject to processing being completely and accurately captured?
- How is data security, privacy and protection maintained?
- In what circumstances should a human override be applied where things do go wrong and how will this be controlled and monitored?

Ensuring the above will provide the trust and confidence required to accelerate AI adoption and gain full benefits for the organisation.

Conclusion

As the adoption of AI and other related technologies becomes more prevalent, organisations will increasingly need accountants who have technology skill sets as well as a deep understanding of the business and accounting context that surrounds data and insights derived from that data.

This presents a great opportunity for the development of outstanding careers in the finance and accounting profession. Those willing to invest the time and effort now to upgrade their skills and take a lead to embrace the potential of AI technologies will benefit the most. Through the use of AI and ML, the technology enabled finance profession has the potential to be one of the greatest contributors to business leadership and excellence for any organisation in the future.

CYBERSECURITY – A CATALYST FOR BUSINESS GROWTH IN THE DIGITAL AGE

CHAPTER 4

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Key points for finance executives:

- Establish a positive cyber security culture within your organisation to mitigate the risks of human factors.
- Identify your business-critical systems and ensure you have sufficient protection around that.
- Recognise that risk can also come from the third parties that you work with.
- Prepare for the worst – have effective cyber contingency plans and test your defences.
- Establish cybersecurity as your strategic competitive advantage.

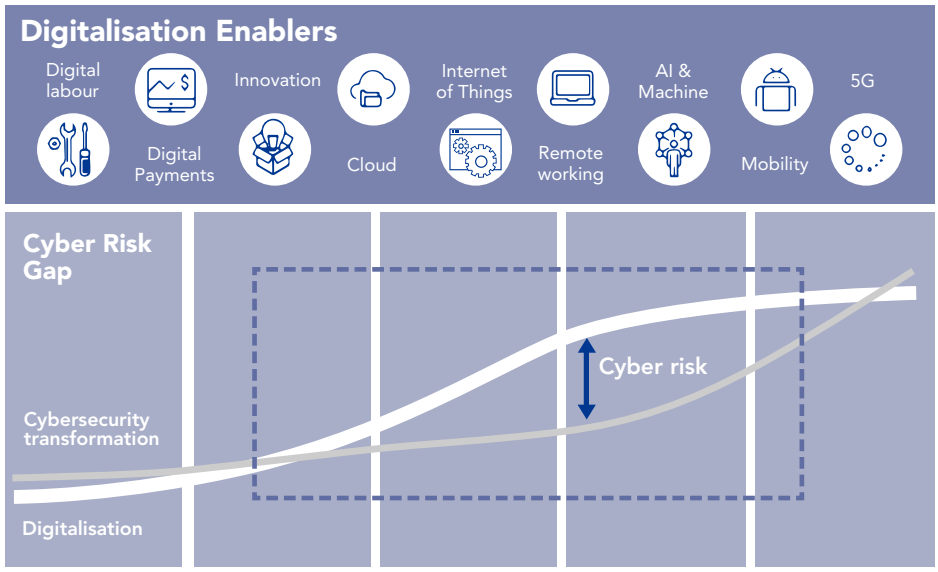
Digital transformation catalysts and cybersecurity

Over the past decade, cybersecurity has become a significant strategic consideration for organisations. Driven by the mass adoption of the Internet at the turn of the millennium and the rapid adoption of technological aids to gain a competitive edge, cybercriminals constantly find new, evolving and sophisticated methods to gain financial advantage from businesses. This phenomenon requires a systematic approach to identify and deal with changing cyber risks effectively.

Consider the COVID-19 pandemic, a catalyst for the adoption of remote work arrangements. Most organisations turned to technological solutions to support new ways of working with the potential to open them up to previously unconsidered threats. For many, it was a necessary risk for the survival of the company.

COVID-19 is not the first, nor will it be the last catalyst of digital transformation, with the lessons learnt throughout 2020 applicable into the future. With the increasing digitalisation of corporate assets, a proportional increase of cyber risk must be considered part of corporate risk.

Figure 1 - The Cyber Risk Gap



Much like the early adoption of the Internet, which caused similar tech adoption waves, this pandemic has a similar impact. However, in contrast to the boom and bust of the dot-com bubble and speculation of where the value lies in the growing Internet domain, COVID-19 has given organisations no choice but to embrace these tools entirely. Now with core business processes conducted remotely, the success or failure of organisations rely on the ability to manage cybersecurity effectively.

As more and more businesses transition to digital processes, a comprehensive approach is necessary to ensure that business assets and value are protected. Companies can apply the lessons learnt during the pandemic on the fast roll out of solutions to closing the cyber risk gap as new digital tools are adopted.

Cybersecurity is a journey, not a destination

From the growth driven nature of our economy, it can be easy to perceive that an increase in security controls may hinder the flexibility of the business, with other factors taking precedence, putting cybersecurity on the backburner. In the end, how many locks do I need to put on my front door before it seems excessive?

We are sure your resident security professional or consultant has said something along the lines of, "Protect the crown jewels" or "Do a risk assessment". While frameworks such as NIST CSF[1] and ISO/IEC 27001[2] exist to help guide and address how to control cyber risk, the application and organisational understanding of these controls is easier said than done. Just applying the controls does not guarantee immunity from all risks.

Take the NIST Cybersecurity Framework, a gold standard and robust set of principles and controls that helps bridge the gap between your current and future state. Separated into five key domains: IDENTIFY, PROTECT, DETECT, RESPOND and RECOVER – what do these mean to the business?

As a guide, these frameworks are of great value to organisations to help map their current cybersecurity journey; however, there is no one-size-fits-all approach. Cybersecurity requires a balance of both technical know-how and the dynamics that make an effective business.

KPMG often sees many companies struggling to find this delicate balance effectively. However, using a multi-pronged approach considering three core elements – 'People', 'Process' and 'Technology', as well as understanding your organisation's risk profile and customising existing frameworks is considered best practice.

Distilled to its core values, the elements of People, Process and Technology encourage organisations to think multidimensionally, consider the people that do the work, the processes that make them efficient and the technology that makes it all possible. Donning the lens of cybersecurity and assessing best practices established by NIST CSF and ISO/IEC 27001, the following questions serve as a guide in building holistic cybersecurity and are good thought provokers while considering cybersecurity.

[1] *National Institute of Standards and Technology (NIST) Cybersecurity Framework (CSF)*

[2] *International Organisation for Standardisation (ISO)*

People

- Does the organisational culture encourage staff across all departments to take cybersecurity seriously?
- Do you have the right cyber leadership?
- How informed is the senior management on cyber risks?

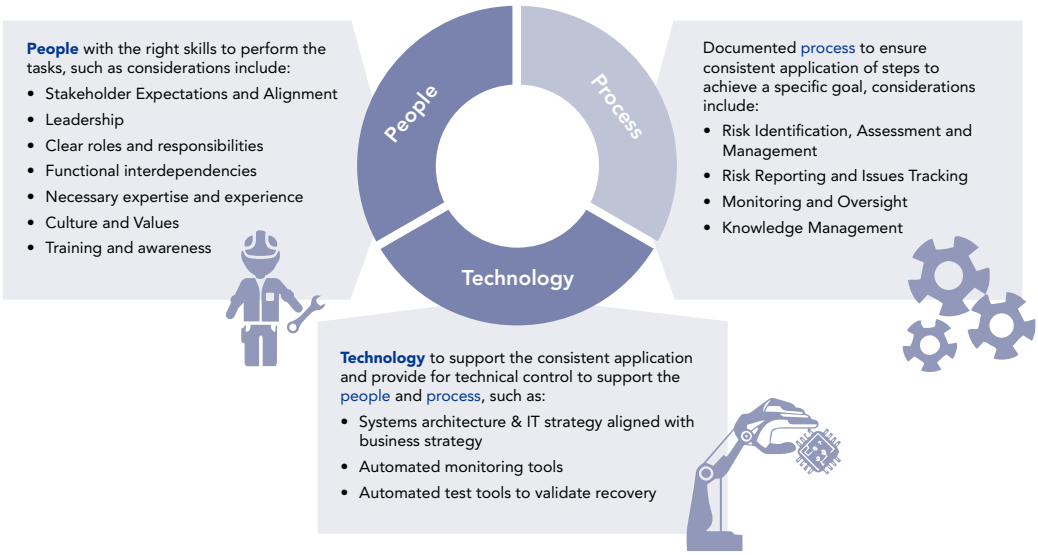
Process

- What structures are currently in place to manage cyber risk?
- How do teams go about achieving their goals?
- How do you identify and mitigate cyber risk?

Technology

- How is technology used to enhance your overall cyber posture?
- What considerations are taken when adopting new technology?
- How can cyber activities be automated and optimised using technology?

Figure 2 - People, Process and Technology



Cybersecurity – "It's not my problem"

A company is only as good as its people. Considering that 90 per cent of data breaches are caused by human error[3], many organisations incorporate a cyber strategy and seemingly mature measures to mitigate the cyber risks.

[3] *Spadafora, A. (08 May, 2019). 90 percent of data breaches are caused by human error. Retrieved from TechRadar: https:// HYPERLINK "http://www.techradar.com/sg/news/90-percent-of-data-breaches-are-"www.techradar.com/sg/news/90-percent-of-data-breaches-are-caused-by-human-error*

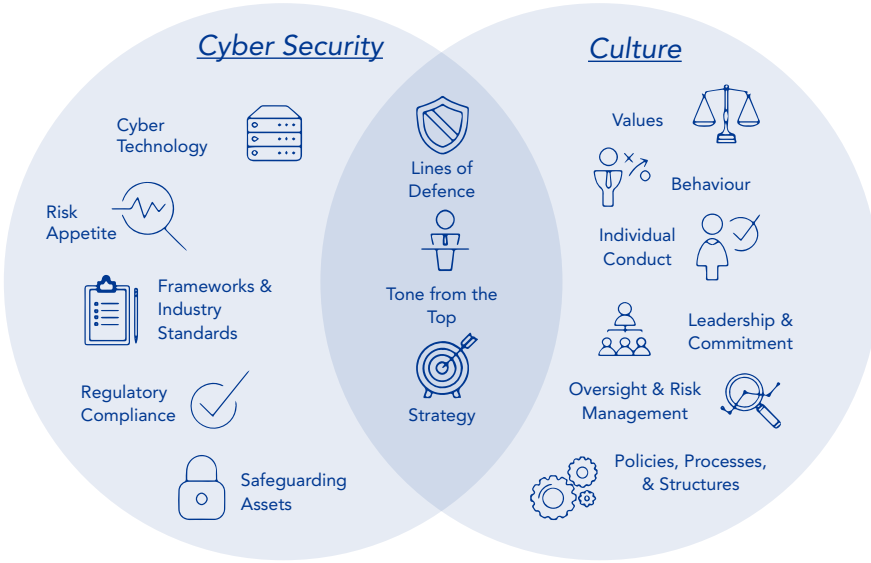
However, many organisations forget Peter Drucker's quote that "culture eats strategy for breakfast". A company can develop the best strategy to manage cybersecurity and fail, as it is still ultimately the responsibility of each employee to ensure its effective implementation.

KPMG has seen companies worldwide grapple with this issue – employees who are not working in IT or IT security departments who do not view cybersecurity as one of their core responsibilities.

Most employees want to do their jobs as efficiently as possible to meet their performance goals. If specific information security requirements and controls may make employees' work more inconvenient, the control may become ineffective. Employees may respond by knowingly circumventing security controls.

Organisations and regulators have increasingly been working to minimise this issue by focusing on building a 'cybersecurity culture' (CSC) throughout the organisation. This includes emphasising the roles each department and employee plays in safeguarding the organisation. Success can be ensured by senior management's strong engagement across all facets of the business, from the security team to all other business units, to promote the development of a mature CSC. By focusing purely on training and awareness rather than explicitly working to change staff behaviour, many employees are likely to be unaware of their organisation's security practices. According to Forrester, 27 per cent of global information workers are aware of their security policies, and at least 8 per cent ignore them[4].

Figure 3 - Intersection of Cybersecurity and Culture



[4] *Budge, J., Blankenship, J., Balaouras, S., Bongarzone, M., & Dostie, P. (2021). How To Manage The Human Risk In Cybersecurity. Forrester Research Inc., p.2*

It's all Greek to me – Understanding and reframing cybersecurity

By reframing cyber risk as a business risk rather than a technical risk, businesses can foster a change in attitude towards cybersecurity. Building an effective CSC starts primarily with the "tone from the top" and with training modules that emphasise that cybersecurity is more than not writing your passwords on a sticky note.

Staff must additionally be motivated, incentivised and engaged to follow good cybersecurity practices, particularly when implementing an organisation-wide strategy that touches all departments. Ensuring all employees can give feedback is key to maintaining healthy engagement with the programme. After all, employees are the ones at the centre of ensuring a CSC takes hold within the organisation.

As a cultural change can never be forced within an organisation, training and awareness programmes should have positive reinforcement rather than purely punitive elements. Making someone take extra training for failing a phishing exercise, for example, is often seen by staff members as nothing more than extra work[5], which does little to ensure those employees come away with a deepened understanding of the risks. A CSC must be established by encouraging employees to take cybersecurity seriously rather than inadvertently pushing them to do the bare minimum.

When a CSC is firmly rooted within the organisation, expanding the cybersecurity strategy to enhance business processes becomes much more manageable. Some processes, such as governance and oversight, can be further developed in parallel.

Who's in charge?

As the saying goes, a car is only as good as its driver. You may have the fastest car, but with the wrong driver, you can still get passed by a professional driver in a lemon. The same can be said for cybersecurity leadership. Today the role of the Chief Information Security Officer (CISO) has been elevated to consider not only technology risk but the risks of how business is conducted, ensuring the cybersecurity practices of an organisation are up to the task of protecting its assets.

In August 2020, the New Zealand Stock Exchange (NZX) made headlines after a coordinated Distributed Denial of Service (DDoS) attack significantly disrupted its operations. With DDoS being one of the most common types of cyberattacks by volume, NZX severely lacked the technological capability to ensure the protection of its exchange[6]. The success of the attack led to the resignation of their Chief Information Officer (CIO) (noting that the NZX did not have a CISO)[7].

Having the right leaders and cybersecurity professionals will serve to effectively guide and identify relevant roles and responsibilities catered to your specific business context. It should also allow for the effective execution and maintenance of your organisation's cybersecurity programme.

[5] *Ibid.*

[6] *Financial Markets Authority. (2021). Market Operator Obligations Targeted Review – NZX - Findings from the FMA's targeted review of whether NZX is meeting its licensed market operator obligations. Wellington: Financial Markets Authority, p.5-6, 9-11*

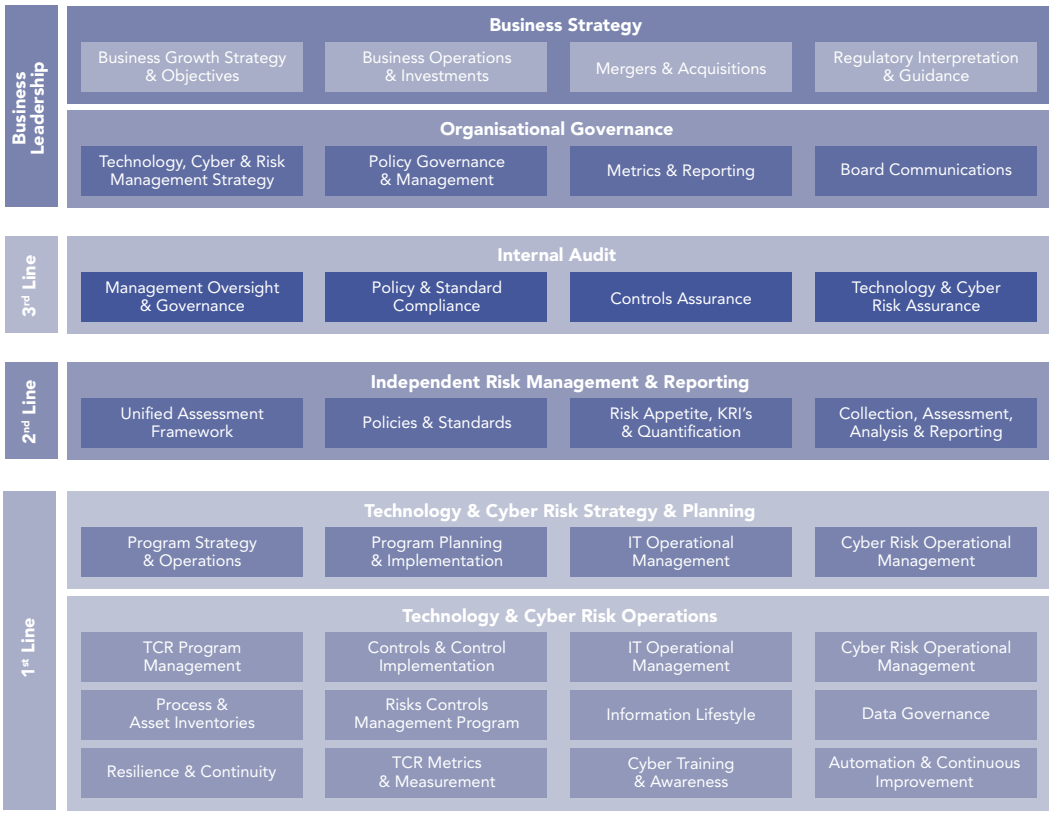
[7] *Keall, C. (29 September, 2020). NZX tech boss quits. Retrieved from NZ Herald: https:// HYPERLINK "http://www.nzherald.co.nz/business/nzx-tech-boss-"www.nzherald.co.nz/business/nzx-tech-boss- quits/74UCH7MBOZCECWP4GE45XODN3A/*

Much to their detriment, many small to medium size organisations may not have specialised cybersecurity roles and responsibilities, such as a Chief Information Security Officer (CISO) function. Instead they have cybersecurity fall under the purview of IT and the CIO who may not have the right skillsets to adequately address technology and cyber risks. This can result in security being considered less of a priority to other day-to-day operations, as the IT department may prioritise simply "keeping the lights on", which may heighten the risk of a successful cyberattack, even a rudimentary DDoS attack.

Breaking it down, organisations should consider the following for cybersecurity governance:

1. Find the right cyber leadership to guide and tailor a cybersecurity strategy for your organisation.
2. Define security responsibility for operational teams. Take the three lines of defence (3LOD) model as an example of the "maker-checker" concept and apply this to security governance. This will ensure that IT or cybersecurity roles are performed, checked and independently tested, and tailored to manage the risks pertinent to your organisation.
3. Measure and track the performance of the defined roles by identifying key performance indicators, as well as key risk indicators for cyber risk.
4. Communicate cybersecurity strategy across the organisation, ensuring a clear reporting structure to the board.

Figure 4 - Detailed 3 Lines of Defence Governance Model



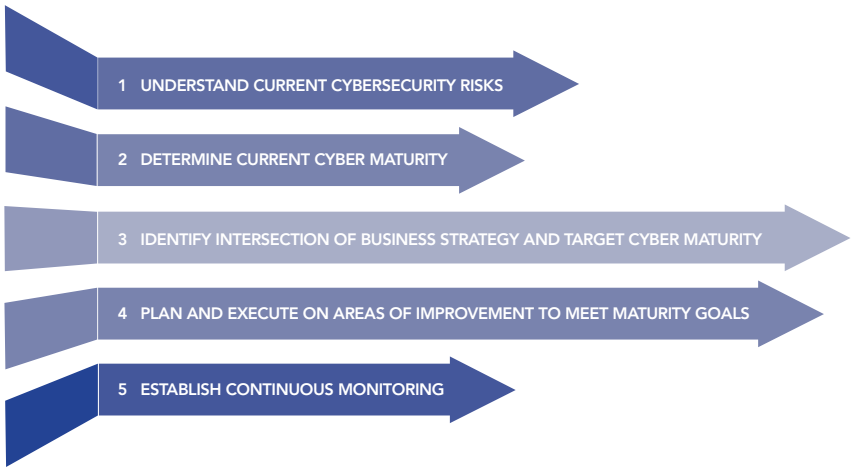
What's the plan?

Understanding where you currently stand in your cybersecurity journey is crucial to developing a cohesive cybersecurity strategy that considers the business's context, including the product or service, industry, company size, and geography. For example, the level and type of cybersecurity controls for a global bank will be vastly different from that of a local retailer.

Identifying the level of controls the more mature organisations in your industry has is an excellent first step to determine what should be implemented. With the industry benchmark in mind, the strategy should be further informed by conducting an assessment against industry-standard frameworks such as NIST CSF and ISO 27001.

This provides a detailed understanding of your current level of cyber maturity and what aspects of your existing cybersecurity programme need to be enhanced, and which processes need to be appropriately defined and documented to ensure repeatability. The reputation and universal acceptance of these frameworks and specific controls will also give the strategy legitimacy and secure buy-in from all departments, and ensure the required budget is allocated.

Figure 5 - High Level Cybersecurity Strategy



The cybersecurity strategy must be backed by an appropriate budget if it is to be effective. To determine a reasonable budget, a quick comparison to industry peers is an excellent place to start. An increasing fraction of the IT budget spent on security is proportional to a greater reliance on technology. Take an e-commerce provider compared to a brick-and-mortar shop; the former will need to spend more on security considering the entire business exists in the digital cyber domain.

As a starting point, a baseline of 10 per cent of the IT budget can be considered, increasing or decreasing based on the nature and the cybersecurity risk posture of the organisation. Government institutions, or providers of critical infrastructure, such as utilities and telecommunications, generally spend more on cybersecurity than companies in the manufacturing sector[8] due to the different levels of cybersecurity risks faced by these industries.

[8] *Pollard, J., McClean, C., Pikulik, E., & Dostie, P. (2019). Security Budgets 2019: The Year Of Services Arrives. Forrester Research Inc., p. 3-4*

In KPMG's view, it is vital to have good risk management practice within the organisation to identify its current cybersecurity state. It will help senior management decide the organisation's future state by looking at the current risk posture.

Figure 6 - Cybersecurity Awareness Lifecycle

Identify and protect your crown jewels

Asset management lies at the intersection of process and technology. In KPMG's experience, many less mature organisations open themselves to unnecessary cyber risks by being unaware of the complete list of IT assets used throughout the organisation. This can, for example, lead to people's work laptops and phones not having the latest security patches, which can, in turn, allow attackers easy access to the corporate networks. Additionally, doing a stocktake of the organisation's information assets helps in a cyber incident, particularly in environments with complex interconnecting and interfacing systems, as incident response personnel will know exactly where to go to access a given system.

The primary focus of any asset discovery exercise is to identify the software and hardware assets critical for the business to continue normal operations – the 'crown jewels'. It is crucial to ensure that this exercise is collaborative between IT and business units as no organisation will have the resources to protect every asset under its control. Therefore, many organisations will establish a baseline standard of protection and place greater emphasis on ensuring the resiliency and security of the identified crown jewels. Also, the practice of identifying these critical assets helps guide remediation and recovery activities based on the criticality of the asset, ensuring that an adequate level of control is in place.

As part of monitoring these assets, organisations often take measures such as additional vulnerability assessments and penetration testing (VAPT) and red teaming assessments. These involve taking on the role of a hacker to try and identify security weaknesses in the asset being tested. These all often draw on cyber threat intelligence sources, which allows the assessments to be based on the tools, tactics, and procedures employed by major cyber threat actors, such as the government-backed Advanced Persistent Threat groups.

Conducting VAPT and red teaming assessments does not guarantee security for crown jewel assets, however. Cyber threat actors not only gain access to organisations' crown jewels through vulnerable systems managed by the organisation but also through systems owned and managed by third parties the organisation may be working with.

What about the people I work with?

A recent development in understanding your cybersecurity context is also considering the third parties that you work with. In 2013, Target suffered a major data breach that exposed names, credit card details, phone numbers, email addresses, and other sensitive information belonging to over 40 million customers. In 2017, Target had to pay settlements totalling US$18.5 million to 47 US states and had to spend over US$200 million in legal fees and other costs as a result[9]. The weak link, in this case, was Fazio Mechanical – a company contracted by Target to manage heating, ventilation, and air conditioning (HVAC) systems – which was subjected to phishing attacks and eventually allowed hackers to steal credentials that gave access to the portal used by Target[10].

Supply chain vulnerabilities are becoming an increasingly common vector for attackers due to lack of visibility and control over third party suppliers' environment and the potential to wreck large-scale havoc on the entire supply chain. Companies should implement a robust third-party risk management (TPRM) programme to manage the cyber risks associated with the end-to-end life-cycle of outsourcing arrangements. This should govern processes ranging from simple application programming interface (API) integrations to deep infrastructure level integrations.

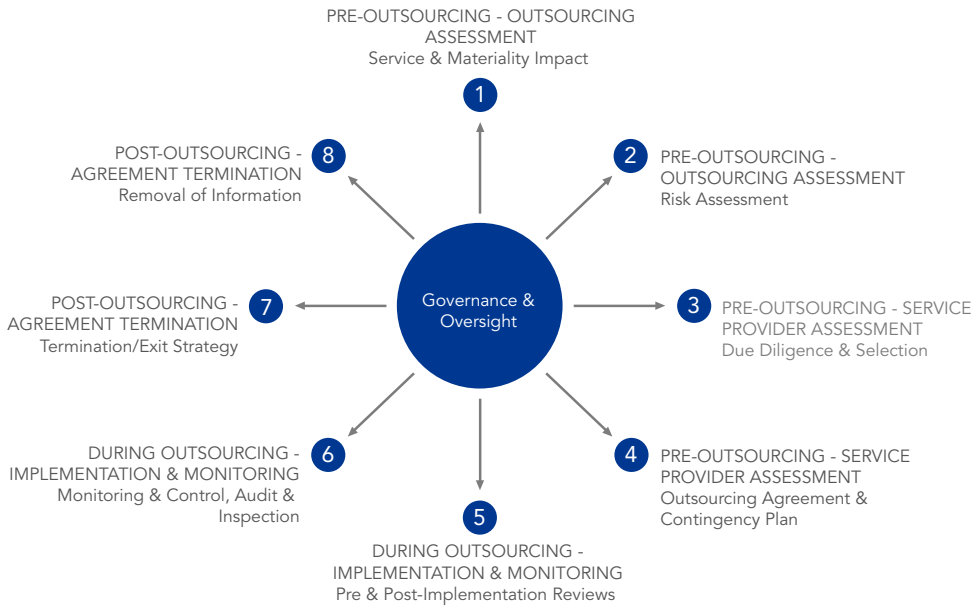
More recently, SolarWinds Orion – a system used by over 300,000 public and private organisations worldwide to manage IT resources – was hacked, with malware being inserted into software updates. Up to 18,000 organisations around the world were compromised as a result, including several government agencies, making it, according to Microsoft, one of the "the largest and most sophisticated attack the world has ever seen."[11]

[9] *Abrams, R. (23 May, 2017). Target to Pay $18.5 Million to 47 States in Security Breach Settlement. Retrieved from New York Times: https:// HYPERLINK "http://www.nytimes.com/2017/05/23/business/target-"www.nytimes.com/2017/05/23/business/target- security-breach-settlement.html*

[10] *Markowsky, G., & Markowsky, L. (2014). From Air Conditioner to Data Breach. Proceedings of the International Conference on Security and Management (SAM). Las Vegas: The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), p. 1-3*

[11] *Reuters. (15 February, 2021). SolarWinds hack was 'largest and most sophisticated attack' ever: Microsoft president. Retrieved from Reuters: https:// HYPERLINK "http://www.reuters.com/article/us-cyber-"www.reuters.com/article/us-cyber- solarwinds-microsoft-idUSKBN2AF03R*

Figure 7 - Key Cybersecurity Outsourcing Consideration



Security now or later?

Organisations who have not been victims to major cyber incidents may be more reluctant to proactively invest in robust cybersecurity measures, whereas those who have suffered incidents generally become more motivated to invest higher proportions of their budget to ensure the development of a mature cyber posture.

We are often asked the importance of being proactive in the development of a cybersecurity programme. The prospect of lower costs versus a fully developed approach can be pretty appealing. If essential security functions have KPIs impacted by a cost saving mentality, it might seem to be the right decision to make at the time.

KPMG has observed time and again that the cost of considering security upfront is significantly less than dealing with the aftermath of a successful cyber attack. When addressing cybersecurity in a proactive manner, the only costs organisations have to worry about are financial and those relating to resourcing. By comparison, if an organisation is not proactive in their approach to cyber and only starts seriously investing after an incident, the costs include those relating to forensics, potential fines/regulatory investigations, customer defections and reputational damage. These are all in addition to the costs incurred as a result of improving the organisation's overall security posture. Altogether, this can potentially be a death sentence for a company. Therefore, it is essential to consider that as companies continue to place greater reliance on technology, security should be considered as an essential element or hygiene factor which must be at the forefront of the C-Suite's concerns. When a strategic change project utilises technology as an enabler or for innovation, then cyber security should be seen as an equal investment priority in lock-step with the investment in IT. Ultimately, recognising the importance of protecting your assets early can be a defining competitive advantage.

Get the basics right.

It may seem easier said than done, but by implementing the basics, cybersecurity hygiene principles go a long way in shoring up your defences.

The adoption of secure software development life cycle (SDLC), whose principles can be applied to all IT projects, emphasise this. At its core, secure SDLC involves looking at security first and including testing throughout the lifespan of a piece of software. The same approach can be applied to implementing new technology such as hardware or tools to facilitate work.

Something as simple as ensuring that all your patches are up to date helps protect from the latest vulnerabilities. In an organisation with 1000 employees, if even 1 per cent have not installed the latest security patch for Windows, potential hackers are presented with a way to compromise critical systems. To minimise the likelihood of that happening, they opt to require every employee to login to a virtualised environment, which will constantly be updated. No matter the current patching of the device, once using the virtualised environment, they will be in a patched environment.

Similarly, with access management, solutions that may seem obvious such as locking your door, must be applied. Take a hotel as an example and the concept of user access management and segregation of duties. If I am a regular vacationer, after checking in, I receive my hotel key card. It acts two-fold, first to provide me with access to only the floors I need to get to, and second to open my specific room. Swiping my card and trying to get to another floor I am not supposed to access will not work.

In the same hotel, now consider a thief who has found a hotel key card lying on the ground and has malicious intent. While the thief has access to specific floors, the majority are inaccessible. Even the room the key is supposed to open remains unknown to the thief. Applied to technology, the same approach is a key mitigating factor. This includes following, segregation of duties and having a "need-to-know" and "need-to-do" approach, only giving users access to what they need.

If the same hotel was more relaxed with its security and a key card gave access to every floor, the likelihood of finding an open door would be higher.

In broad terms, cybersecurity risk can be seen through two lenses: the probability of an incident in comparison to the likelihood. In statistics, there is an important distinction between the two – where probability looks at the chances of something happening, likelihood looks at maximising the chance of a specific outcome taking place. In our hotel example, the potential for a hotel guest to lose their room key is ever-present – however, we can reduce the likelihood of theft through additional controls.

It's not a question of if, but when

Benjamin Franklin's quote - "If you fail to plan, you are planning to fail!" accurately describes preparedness for cyber-attacks becoming increasingly sophisticated and inevitable. This has caused a mindset shift in companies from "we should do all we can to secure our systems from a cyber-attack" to "how do we best equip ourselves to detect cyber-attacks early and respond to and recover from them effectively". This has resulted in the trend among companies to develop business continuity plans (BCPs) and disaster recovery (DR) plans, which focus extensively on cyber-attacks in addition to scenarios such as natural disasters and terrorist attacks, and pandemics.

One of the main shortcomings that we have seen with high-profile cyber-attacks is that the target is not prepared adequately to manage a large-scale cyber-attack. For example, companies may not have established backup plans for scenarios when their critical IT systems and data were unavailable. Further, they do not evaluate the business impact caused by cyber-attacks and develop procedures and workarounds during such scenarios.

Practice makes perfect

In medical emergencies, the "golden hour" has been termed as the 60 minutes right after an incident when intense trauma care must be initiated to improve the patient's outcomes. A similar concept is applicable during cyber incidents, where time is of the essence. The more time it takes to respond to and recover from the incident typically leads to higher financial costs and reputational damage.

Increasingly, regulators worldwide have established strict cyber incident and data breach notification requirements that organisations need to comply with.

Given that the response time is often limited, and many activities are required, we recommend the following for managing cyber incidents:

1. **What:** Develop cyber recovery plans and run exercises for specific cyber incidents such as ransomware and data exfiltration.
   Why: Set steps that technical teams should follow during a cyber incident to remove the guesswork and improve response time.
2. **What:** Identify critical business processes, data and IT systems based on the business requirements and develop recovery plans.
   Why: In case of business disruptions to multiple vital processes, the company is aware of the critical resources (people, processes and technology) and can systematically initiate recovery to reduce the business impact.
3. **What:** Train incident response teams on technical cyber incident discovery and response, and drill senior management on crisis management and communications.
   Why: Training at all levels of an organisation is critical. KPMG has noticed that information communication and escalation protocols are often not defined, and that slows down incident and crisis response.

What's next?

As organisations become more digitalised, the threat from increased cyber risks is inevitable. However, these risks can be managed effectively and should not be a deterrent to innovation. An innovative mindset and a risk-focused mindset go hand-in-hand.

As a starting point, organisations should try and understand where they currently are on the cyber journey and where they want to be, considering the rapid pace of technological change and assessing how cybersecurity can be incorporated into their business digitalisation strategy to ensure sustainable growth. Through the guiding lens of People, Process and Technology, the following principles can be implemented to promote an effective cyber risk and assurance programme:

1. Find the right cyber leader to guide the creation of effective cyber governance.
2. Establish a positive cyber security culture within your organisation to mitigate the risks of human factors.
3. Use leading cybersecurity frameworks to assess your current maturity and guide your overarching cybersecurity strategy.
4. Identify your business-critical systems' and ensure you have sufficient protection around that.
5. Always maintain "Need to Know" and least privilege principles.
6. Recognise that risk can also come from the third parties that you work with.
7. Embed security in every stage of your application development and change process.
8. Get the basics right and patch.
9. Prepare for the worst - have effective cyber contingency plans and test your defences.
10. Establish cybersecurity as your strategic competitive advantage.

HOW BLOCKCHAIN CAN ENABLE DIGITAL TRANSFORMATION IN FINANCIAL SERVICES

CHAPTER 5

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Key points for finance executives:

- Blockchain technologies are in their early stages of development and show promise in forming the foundation of next-generation financial services infrastructure.
- As a digitised, secure, and tamper-proof ledger, blockchain can enhance accuracy and information-sharing in the financial services ecosystem.
- The growing interest and experimentation with blockchain is tied to its potential in driving operational efficiency, improved regulatory compliance, faster and cost-efficient payments, enhanced security, greater transparency, and risk mitigation.
- The actual applications of blockchain are still evolving and financial institutions need to take a long-term view to maximise its utmost potential.

Introduction

Blockchain technology has the potential to reshape the way businesses transact across industries globally. Enterprises are piloting blockchain technologies to test how it can drive greater transparency, traceability and operational efficiency for a multitude of business transactions and contracts.

Blockchain technology may disrupt business, with the financial services sector likely to be one of the most impacted.

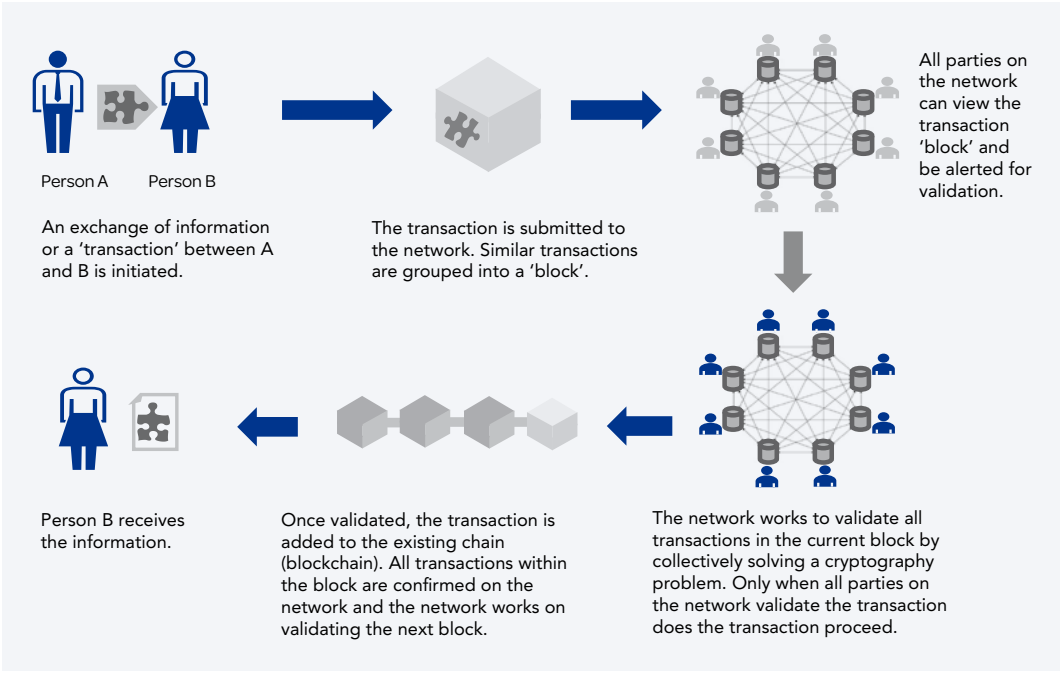
This chapter discusses how blockchain technology works and outlines key opportunities and challenges to its application in the financial services sector. It also explores blockchain adoption and innovation through use cases within different financial services segments including lending, trade finance, asset management and insurance.

What is blockchain?

Blockchain is a distributed database of records of all transactions or digital events that have been executed and shared among participating parties. These exchanges can be done without the need for a central authority. Simply put, "blocks" on the blockchain are made up of digital pieces of information. They store information such as transaction and participant details, which are recorded using a unique "digital signature". Just like how names create separate identities for individuals, each block stores a unique code called a "hash" that differentiates from other blocks and are included in the subsequent block creating a link among the blocks. See Figure 1 for an illustration of how blockchain works.

Blockchain applications can also run smart contracts. Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met. They are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome. They can also automate a workflow, triggering the next action when conditions are met.

Figure 1: Like a traditional ledger, individual transactions (blocks) are added to the ledger (the chain) and this process is irreversible.



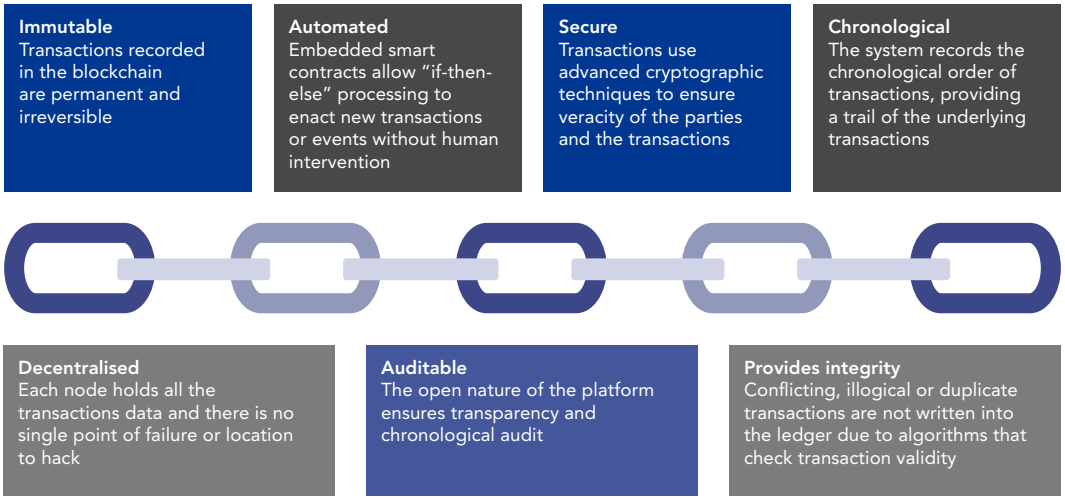
In a real-world application of smart contracts, a major French travel insurer launched its parametric insurance, which provides policyholders the option to claim payout on the occurrence of a triggering event, being delayed flights. Blockchain technology enabled the insurer's platform to be fully automated and secured, where it was able to offer automatic compensation to policyholders whose flights were delayed by more than two hours.

It worked by automatically recording insurance purchases in a tamper-proof blockchain platform. As the platform was connected to global air traffic databases, upon receipt of information of flight delays beyond the threshold of two hours, compensation would be triggered automatically through "if/then" conditions encoded onto smart contracts. In this way, the insurer delegated the compensation decision to an independent network, improving the customer experience.

Key attributes

Blockchain replicates and authenticates transactions, which are encrypted by strong cryptographic techniques, across a participating network. This ensures that transactions can be initiated only by certified parties, changes are validated by participants collectively, and the outputs of the system are immediate, accurate, and irrevocable. This could potentially shift the locus of trust from individual entities to an independent system and may eliminate the need for transaction intermediaries such as banks, governments, and other businesses to act as the sole authenticator of any transaction. See Figure 2 for a summary of its key attributes.

Figure 2: Attributes of the blockchain technology



Types of blockchain

Many industries have started to pilot blockchain technology, with some enterprises incorporating it into their systems. Each industry functions uniquely, driving the development of different types of blockchains.

In general, there are public and private blockchains. Their key differences are described in Figure 3 below.

Figure 3: Two key types of blockchain systems exist given varied adoption and useability.

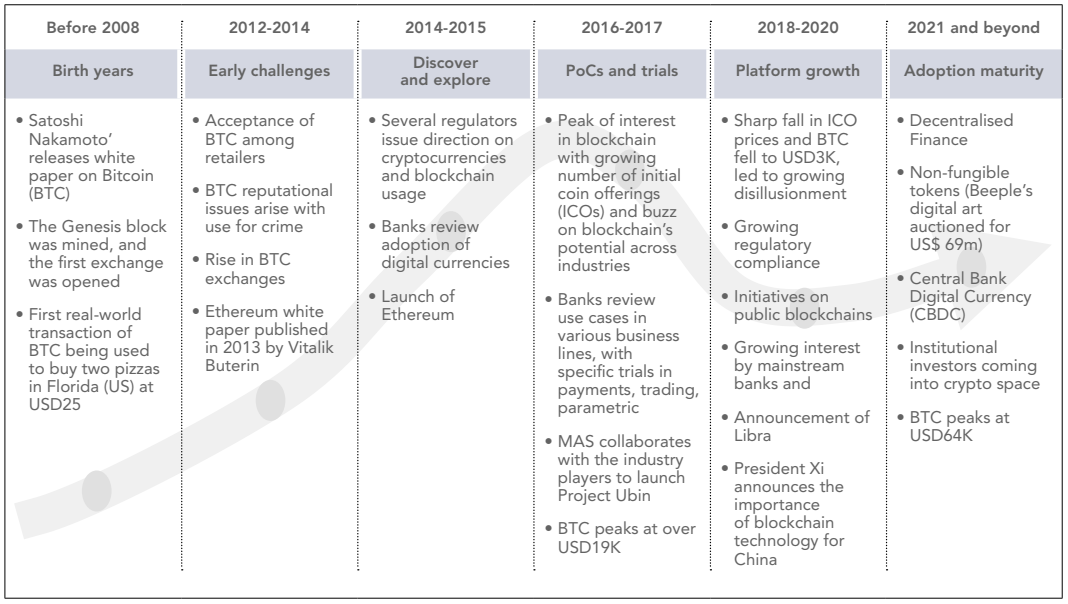
	Public and permission-less	Private and permissioned
Definition	Open to all	Restricted and access-based
Proposition	Greater transparency, free participation in voting and consensus, and fully decentralised	Preserves privacy, more energy efficient, and more control (i.e. less decentralised)
Examples	Bitcoin, Ethereum, Neo, Litecoin etc.,	Hyperledger Fabric, R3 Corda, Quorum etc.,
Owner	All participants (decentralised)	One central institution or consortium members
Governance	Rules defined at inception	Rules defined by institutions and consortium members preferences
Transparency	Fully transparent	Access-driven transparency

Evolution of blockchain in financial services

The last few years have witnessed increasing trialling of blockchain technology in the financial services industry, ranging from digital currency exchanges to ongoing proofs-of-concept (PoC) in payments, lending, asset management, trade finance, capital markets, insurance, and central banks (see Figure 4).

Several financial institutions are currently testing blockchain in controlled environments, and these prototypes could be implemented more broadly in coming years. The impact of blockchain technology could be felt sooner than expected with high-speed broadband networks as the supporting underlying infrastructure.

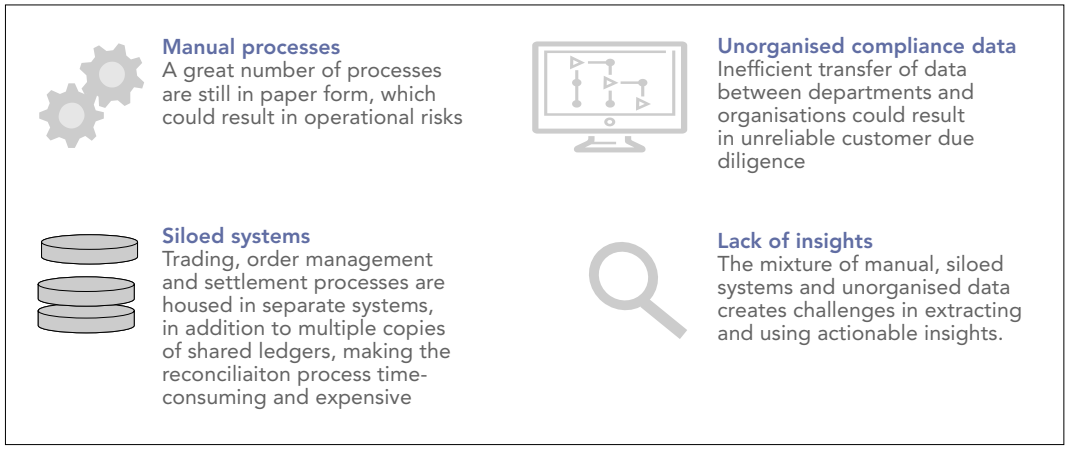
Figure 4: Adoption and capabilities of blockchain will continue to expand in the coming years in financial services



Blockchain application and use cases

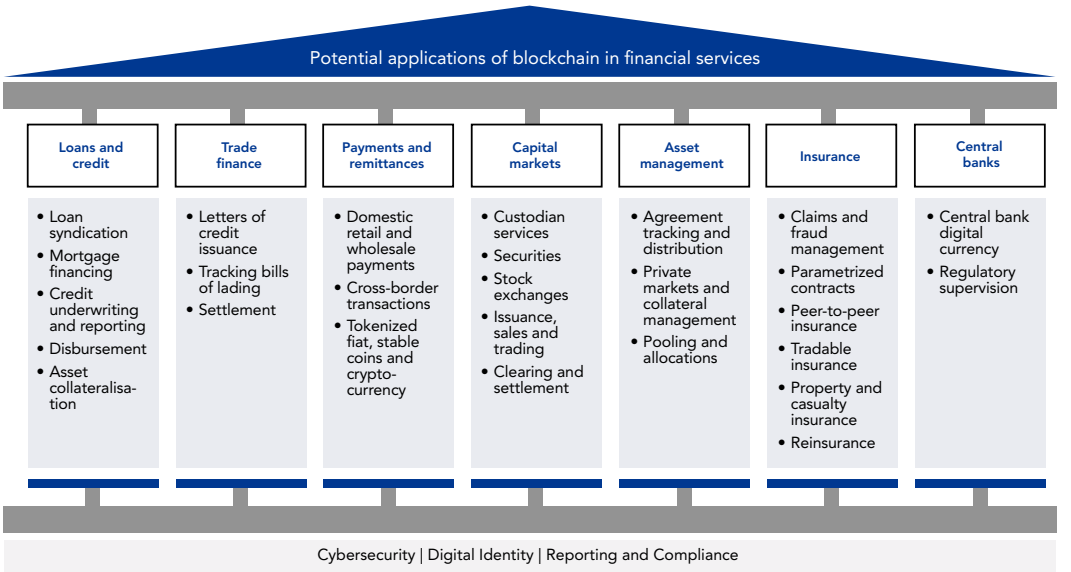
Amid sweeping regulatory changes, disruption from non-traditional competitors, as well as heightened expectations from customers and regulators for trust and transparency, financial services institutions are focusing on digitally transforming their organisation. Such institutions will find transformation particularly challenging due to manual processes, unorganised compliance data, siloed systems and lack of insights (Figure 5).

Figure 5: Common challenges in the financial sector



Blockchain solutions can help organisations to address the abovementioned challenges. This section discusses how blockchain technology has the potential to transform financial services sector across industries and segments, illustrated with use cases (Figure 6).

Figure 6: Segment-specific use cases of blockchain



Loans and credit

The global syndicated lending market in 2020 reached US$3.5 trillion, where US$461 billion in loan volumes were in the Asia-Pacific, according to Refinitiv's report[1]. Traditional lending processes are struggling to keep pace with rising loan volumes as well as changing customer expectations. Existing syndicated lending processes reside in siloed systems, require significant human intervention and multiple processes with each of the lenders in the syndicate, resulting in delayed settlements that could take between 30 to 60 days.

Blockchain can help address these inefficiencies by automating syndicate formation through smart contracts, programming underwriting and diligence activities, and facilitating AML compliance.

In 2018, the first globally syndicated loan that leveraged blockchain technology was granted to a partly state-owned Spanish corporation by a major Spanish bank partnering with two other banks. It was completed at record speed using the bank's proprietary platform powered by Distributed Ledger Technology (DLT), which is another name for blockchain technology.

Blockchain technology can transform both corporate and consumer lending, including how financial institutions handle mortgages. Specifically, the technology can remove cost and friction from the process, create secured transaction records and facilitate instant settlement. It can also transform the way mortgages are serviced and sold in the secondary market. Examples of the potential application of blockchain technology to achieve this include:

[1] *"Global Syndicated Loans Review", Refinitiv, FY2020, © 2020 Refinitiv*

- In 2016, a digital bank in China leveraged blockchain for its micro-loan product, inserting it into a popular social networking app. Within two years, millions of interbank reconciliations had taken place and this micro loan product contributed to a substantial portion of the bank's profit.
- A major Hong Kong bank is presently processing the majority of its mortgage-related property valuations with blockchain technology.

Trade finance

Around 80 per cent of world trade in 2020 relied on trade finance, according to the International Chamber of Commerce[2]. Given the significance of the trade finance market, it is concerning that the trade financing gap, which refers to the amount of requested trade finance that is rejected, continues to widen. This gap, which is valued at an estimate of US$2 trillion to US$5 trillion in July 2020 according to the World Trade Organization, has continued to expand during COVID-19[3]. Small and medium enterprises have been hit the hardest and faced high rejection rates due to lack of visibility, operational difficulties, high perceived risk, and cost-to-serve.

A typical trade transaction goes through numerous paper-based manual processes and compliance checks during its life cycle, and may be challenged by delayed timelines and fraud risks. Blockchain technology can mitigate these challenges by enabling real-time verification of personal, financial and trade documents i.e., letter of credit and bill of lading. It will also create greater trust and transparency between parties, mitigating fraud risks. By improving the veracity, speed and security of trade financing requests, this can help increase the approval rates of trade financing requests.

This is seen in a Singapore-based blockchain trade finance initiative in 2020, where the entire process of executing a letter of credit was completed within 24 hours rather than 8 to 10 days, thereby allowing it to launch commercially the next day.

Given the potential impact of blockchain solutions in narrowing the trade finance gap, it is not surprising that both governments and financial institutions are investing in this area. In 2017, the Hong Kong and Singapore central banks agreed to cooperate on a cross-border trade project based on blockchain technology as part of a broader joint strategy on financial technology. In 2020, a major bank in Singapore, with the support of other banks, commenced a project that will use a blockchain network to register trade finance transactions. The same bank became the first Asian bank to transact on a blockchain-based trade financing platform.

Payments and remittances

The global payments industry is undergoing significant disruption, driven by changing customer demands, complex regulatory requirements, outdated legacy infrastructure, and an increasingly competitive marketplace. The traditional payments ecosystem was not built to support real-time payments. Existing payment value chains that involve stages such as payment gateways and exchange modes require multiple issuers, parties and authorisations to complete a single transaction. The overall processing time required makes it a challenge to realise real-time payments and adds to the infrastructure and transaction costs.

[2] *"TRADE FINANCING AND COVID-19: Priming the market to drive a rapid economic recovery", International Chamber of Commerce, May 2020*

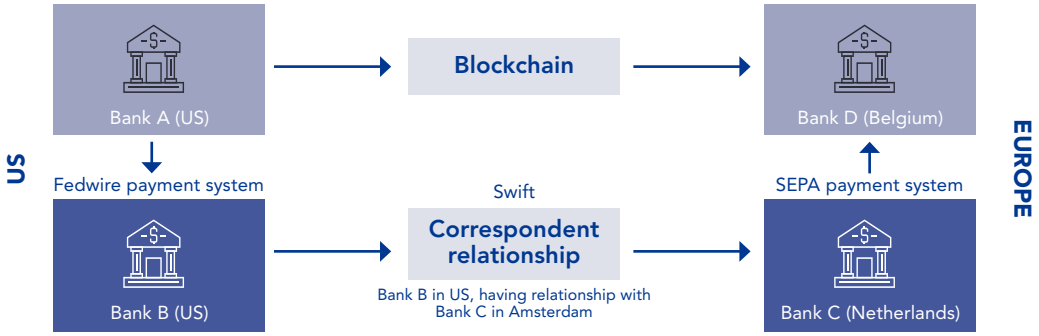
[3] *"WTO, ICC and B20 call for action to narrow the growing trade finance gap", World Trade Organization, July 2020*

Blockchain can address this issue as it enables real-time execution of payments, removing the need for verification from third parties and reducing processing time. See Figure 7 for an illustraton of how blockchain technology works in payment transactions. It also creates transparency that can help in real-time fraud analysis and prevention. Given that facilitating cross-border payments is highly lucrative for banks, this is an area that is continuing to attract investments in blockchain developments.

Examples include:

- In 2019, a Singapore-based payments FinTech partnered with a blockchain technology firm to implement DLT in payments processing, making payments more efficient and transparent.
- In 2020, Singapore's central bank collaborated with two major banks and an investment firm to develop and test a new blockchain-based digital multi-currency payments network to enhance commercial cross-border clearing and settlements globally

Figure 7: Cross-border money transfers from bank A to bank D through blockchain without intermediary



Source: "How Blockchain Is Going To Change The Remittance In 2020", FinExtra, January 2020

Capital markets

The capital markets infrastructure enables the trading of stocks, bonds, and other securities. The potential use cases for blockchain on the buy-side, sell-side and for infrastructure players are wide-ranging.

Currently, processes to ensure regulatory compliance and enable secure, trustworthy trades are highly complex. Clearing these transactions also relies on intermediaries, resulting in inefficiencies and potential exposures to money laundering and corruption.

Stock exchanges are infrastructure players and are testing the use of blockchain technologies to reduce costs, speed up trading and facilitate the secure settlement of these transactions. Blockchain has the potential to make financial transactions and processes more transparent, resilient, and cheaper. In 2018, MAS and the Singapore stock exchange collaborated on Project Ubin to see how DLT can be used towards the clearing and settlement of payments and securities, specifically using a tokenised form of the Singapore dollar on a distributed ledger. Japan is also planning to have a blockchain-based stock exchange in 2022, allowing investors to trade digital securities using DLT.

On the sell-side, custodian banks are under pressure to deliver competitive and cost-effective services. Given the challenges around stringent and complex regulations, legacy infrastructure constraints, and inefficient processes, delivering high customer satisfaction while containing costs remains a challenge. Blockchain technology may help address these issues by creating a decentralised database of unique digital assets and streamlining processes, reducing costs and delivering closer to real-time transactions between financial institutions.

In 2019, a Singapore-based custodian startup on blockchain-based digital assets entered the regulatory sandbox. The startup exited the sandbox in 2021 and was granted the first capital market services license in Singapore to provide independent digital asset custody service. In 2020, the Singapore exchange partnered with a major bank and state investment firm in the issuance of its first digital bond using DLT.

Brokerage houses are another key player in the sell-side that deal with the complexities of post-trade processing. Utilising blockchain and smart contracts can smooth the execution of these processes, ultimately helping to reduce operational and counterparty risks, costs incurred by intermediaries, speed up the settlement time and address inconsistencies in the data.

Asset management

Asset management is a complex process involving multiple intermediaries. The current challenges faced by asset managers include fees and cost compression, and an abundance of unorganised data. At the same time, accelerated technology innovation and continued emphasis on fee transparency are prompting asset managers to rethink distribution and cost transformation strategies.

In the context of digital asset management, managing data security and resiliency are top concerns that are made more complex by the growing number of digital sources. Blockchain technology can help create a collaborative system where multiple parties can participate in secure environments, creating accurate, immutable records of verifiable transactions. It also reduces the need for intermediaries and enables near real-time settlement.

In Singapore, a major financial group is working on a digital exchange by leveraging blockchain technology to provide tokenisation, trading, and a custody ecosystem for digital assets. However, the usage of blockchain in asset management is still in its early days, where regulatory frameworks are still in development and large amounts of data have not been stress-tested on the blockchain.

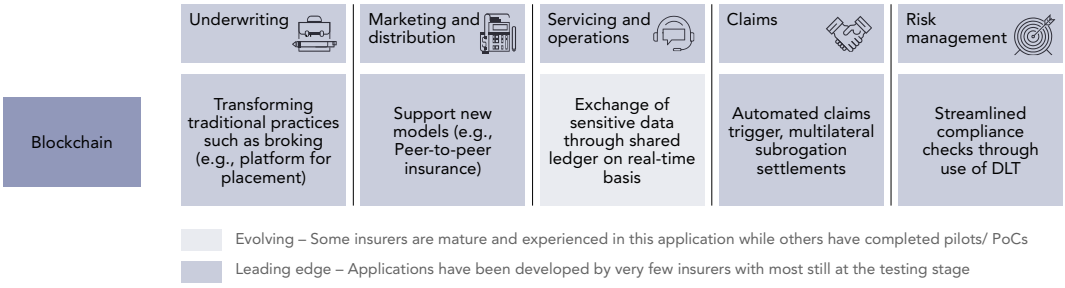
Insurance

The insurance industry is experiencing an evolution in products, services and infrastructure that is being disrupted by the connected world. At the same, traditional insurers face challenges with fraud risks, slow and costly KYC processes, claims management, and enriching the customer experience.

Blockchain may help address some of these critical issues faced by the insurance sector (see Figure 8):

- **Fraud detection and risk prevention:** Blockchain can provide a decentralised data repository to independently verify the integrity of customers, policies and claims with a complete view of the underlying transaction history. This could help reduce errors and prevent fraud.
- **Transparency and trust:** When multiple insurance companies choose to contribute data to the same decentralised and shared ledger, it can create opportunities to eliminate data redundancies, improve the authenticity of data and increase the customers' control over their data.
- **Digital claims management:** Combination of blockchain with AI and machine learning can enable automated claims processing and improve pay outs.
- **Distribution and disruption:** Driving automation to capture risk data in facilities and contracts also offers new opportunities to build market knowledge, automate payments and address financing risk.

Figure 8: How blockchain can transform the insurance value chain



In 2018, in partnership with a major blockchain-based cybersecurity provider and six other players, EY launched Insurwave, the world's first blockchain-enabled marine insurance platform in commercial use. This private blockchain-based SaaS platform integrates and secures the streams of disparate data sources involved in insuring shipments around the world.

Other examples of how blockchain is being in the insurance industry include:

- In 2020, a major Chinese bank launched an insurance blockchain with multiple insurance partners to store policies for transparency and efficiency. A major Philippines life insurer has adopted a blockchain solution for life insurance policy administration and offers low-cost life insurance.
- A US insurance technology (InsurTech) company leveraged AI and blockchain for claim management to turnaround payouts in three seconds for approved claims.

Central banks

Whilst most jurisdictions do not consider cryptocurrencies such as bitcoin to be legal tender, several regulators are deliberating the issuance of Central Bank Digital Currencies (CBDCs) to complement traditional money. According to a 2021 report by the Bank for International Settlements (BIS)[4], over 60 per cent of central banks have been conducting experiments or PoCs on CBDCs, while 14 per cent have developed and piloted arrangements in 2020. Singapore is developing a wholesale CBDC that would enable the settlement of securities among financial institutions.

CBDCs can offer a range of benefits. They have a lower cost of cash and improved KYC and AML controls. CBDC can also support and drive innovations in monetary policy implementations, as well as enable financial inclusion.

There are a number of noteworthy developments on this front. China's national digital currency DCEP (Digital Currency Electronic Payment, DC/EP) i.e., digital yuan built with DLT could become the world's first CBDC. In October 2020, the Cambodian central bank partnered a Japanese blockchain firm to launch a quasi-central bank digital currency. In Singapore, the central bank has made substantial in-roads in blockchain-based multi-currency payments network prototype through phase five of Project Ubin.

Beyond the enablement of CBDCs, blockchain technology can help central banks address key regulatory supervisory issues such as the lack of reporting data quality, high cost of regulatory reporting and supervision, complex infrastructure requirements, increased cooperation between reporting institutions that is hard to establish, and increased fragmentation of regulatory data. Blockchain's distributed, transparent, customisable and secured infrastructure can help financial services regulatory authorities gain efficiencies.

Blockchain supervisory technology (SupTech) is already a part of the central banks' innovation agenda worldwide. In 2019, BIS suggested regulators use blockchain for bank supervision and coined the term "embedded supervision". The embedded supervision concept relies on blockchain-enabled trust mechanisms of decentralised markets for regulatory purposes.

Other potential use cases

Blockchain technology is also being applied to the following areas in financial services organisations, although uses cases are limited:

1. **Cybersecurity:** Blockchain is inherently resilient in mitigating cyber risks, especially for financial institutions. The technology can support secure financial data sharing, anti-money laundering monitoring, encrypted messaging platforms, validate data for the shared ledger's overall robustness and enhance transparency across participants. Despite the abovementioned benefits, blockchain technology is subject to several risks like coding errors, leakage of sensitive financial data, network-level attacks and smart contract vulnerabilities. Thus, implementation will require an iterative and robust cybersecurity program.

[4] *"Embedded supervision: how to build regulation into blockchain finance", Bank for International Settlements, 16 September 2019*

2. **Digital identity – KYC, AML, CFT:** The current KYC and AML/CTF processes used by most financial institutions are inefficient and can take days and even weeks to satisfy regulators' requirements. At the same time, costs are increasing. The decentralised, immutable, and transparent nature of DLT could potentially resolve some inefficiencies in the KYC/AML compliance program. DLT technology platform can empower financial institutions to share a client's KYC and AML data internally across all units and with other institutions with consent from the client, in each case using a permissioned DLT platform. In a use case, a Singapore-based investment portal firm partnered with a tech major to develop a secure blockchain network around KYC compliance.

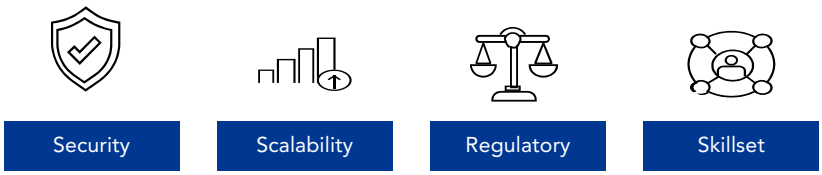
3. **Reporting and compliance:** Financial services companies need to comply with regulatory requirements and complex regulatory reporting and required staffing are pushing costs higher. Blockchain can address several key concerns around manual processes, workforce, and data quality.

   For example, the EY Blockchain Analyzer solution can facilitate and support audit teams in reconciling data between the client's books and records and the public ledger. It helps audit teams understand what clients are doing on the blockchain, and how their business is shaping up in that environment. Auditors can then evaluate the data and perform analysis of transactions, reconciling and identifying transaction outliers.

Key challenges in executing blockchain

While blockchain may create significant opportunities for the financial services sector, several challenges need to be addressed before wider implementation (Figure 9). These include:

Figure 9: Key challenges in executing blockchain technology in financial services



Security: Blockchain-based systems, like any other systems, are vulnerable to security issues. There have been several instances of theft of cryptocurrency. Given the decentralised nature of the technology, authentic identities are never revealed, creating an avenue for criminal and illegitimate activities. Regulations and stronger cybersecurity measures on applications sitting on blockchain platforms are addressing some of these concerns.

Scalability: While blockchain networks work fine for a small number of users, there are scalability issues around broader integration that could slow down the network. Implementation remains a challenge for financial institutions due to their legacy infrastructure. Concerns like scalability and interoperability contribute to high maintenance costs. However, advancements in research and development across several areas have been positive to address scalability concerns. For example, the new version of Ethereum is expected to handle 100,000 transactions per second[5] (from the current estimated 20-30 transactions per second).

[5] *"A Dive Into Ethereum 2.0", CoinMarketCap, September 2020.*

Regulatory and supervision: The regulatory environment is still evolving around blockchain technology. Also, the standards vary by region. The lack of standardisation raises interoperability issues and increased costs, making it challenging for broader adoption.

Some of the progress made on the regulatory front include:

- The European Parliament published a study around blockchain and the General Data Protection Regulation (GDPR) in 2019. It recommended regulatory guidance from the European Data Protection Board (EDPB) to ensure a unified Europe approach.
- In 2021, the US Office of the Comptroller of the Currency (OCC) made a crypto-friendly move by allowing financial institutions to use stablecoins for payment activities and participate as nodes in a blockchain.
- The Singapore regulator has made significant progress around applying DLT in the financial services sector through Project Ubin that started in 2016.

Skillset: Given the nascent adoption and complexity of technology, training and attracting technology talent with the required skillset remains a challenge.

Although initial results from experiments and PoCs with blockchain technology seem promising within financial services, challenges in security, scalability, and regulatory standards are hindering its broader adoption and implementation.

Conclusion

From a macro perspective, financial institutions serve as the critical storehouses and transfer hubs of value. Technology innovation has been fundamental to transformation, and blockchain technologies show promise in forming the foundation of next-generation financial services infrastructure. As a digitised, secure, and tamper-proof ledger, blockchain can enhance accuracy and information-sharing in the financial services ecosystem.

The growing interest and experimentation with blockchain is tied to its potential in driving operational efficiency, improved regulatory compliance, faster and cost-efficient payments, enhanced security, greater transparency, and risk mitigation. The actual applications of blockchain are still evolving. However, the technology is not a fad, and financial institutions need to take a long-term view to maximise its utmost potential.

REDESIGNING FINANCE FUNCTIONS WITH ROBOTIC PROCESS AUTOMATION

CHAPTER 6

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Key points for finance executives:

- Robotic Process automation (RPA) has the potential to perform repetitive and time-consuming tasks with greater efficiency and accuracy than humans, freeing staff up for higher-value and more interesting tasks.
- With complementary emerging technologies such as Optical Character Recognition (OCR), Artificial Intelligence (AI) and Natural Language Processing (NLP), RPAs can also perform tasks that require some form of judgement and decision-making.
- Intelligent Process Automation (IPA) has the potential to cover business processes such as finance, human resources, procurement, IT and audit.
- The business risks of not adopting such technologies could be high, as the organisation starts to lag its competitors in terms of costs, efficiency and speed.

Introduction

The phrase "digital transformation" has attracted growing levels of attention in recent years. It refers to the integration of digital technologies within business processes to fundamentally transform the way organisations conduct their businesses.

It is well-recognised that the COVID-19 pandemic has sparked an increase in the pace of digital transformation across many organisations. Without digitalisation of their work processes, organisations have found it challenging to operate effectively when social distancing and work-from-home policies are enforced in the workplace, thereby threatening their survival.

Beyond the immediate concerns of survivability, the process of digital transformation will also encourage organisations to redesign their work processes to be more streamlined and efficient. This potentially allows them to reduce their staffing needs and ensure their organisations remain competitive and sustainable over the long run.

Digital transformation encompasses many different aspects and techniques. One technique that is growing in importance is robotic process automation (RPA). As with automation in the manufacturing industries that improves the quality and efficiency of the work performed, automation of processes can also benefit organisations from all industries. Based on a survey conducted by Gartner, it was found that organisations deploy RPAs for three main reasons: optimise operational efficiency, accelerate an existing process and optimise cost[1].

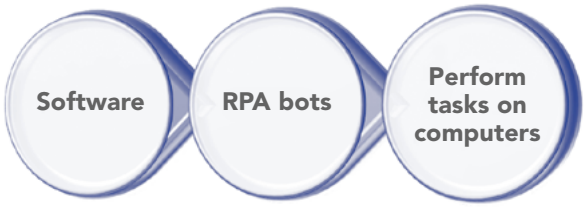
With RPAs being able to improve process quality, increase speed and productivity, while reducing reliance on human workforce at the same time, it has become an attractive technological enabler for many organisations. In the subsequent sections, we discuss what RPA is, how it can benefit organisations and finance functions, and the key points to consider during development and deployment.

[1] *Gartner's Magic Quadrant for Robotic Process Automation (2020)*

Robotic process automation

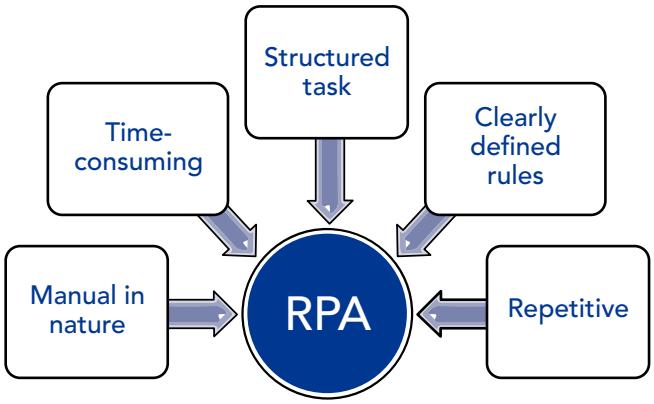
What is robotic process automation?

The term "robotic process automation" was first coined in 1959 by Arthur Samuel who is a pioneer in the field of artificial intelligence. RPA is the use of software to develop software robots or 'bots' to replicate and automate a series of human actions on a computer to accomplish a task.



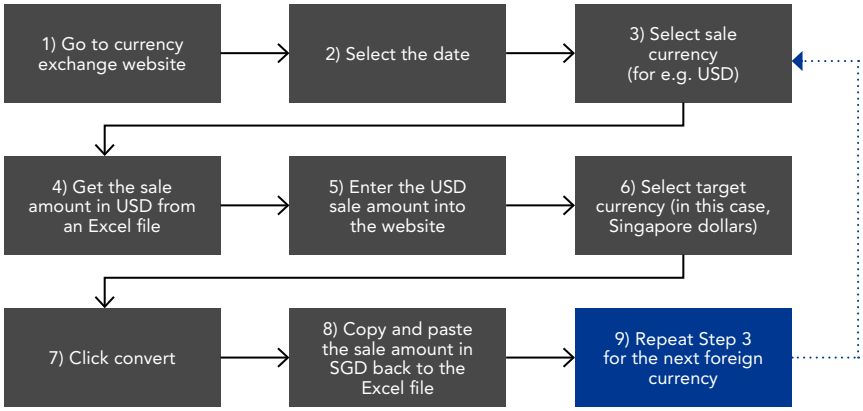
When to deploy RPA?

As with physical machinery, the complexity of RPA can vary as it can be customised to suit a wide range of use cases of various difficulties. Regardless of complexity, RPA bots can outperform humans in terms of speed, accuracy and scalability. Generally, RPA bots excel in scenarios where the tasks are manual, time-consuming, well-defined, structured and repetitive.



A simple hypothetical example of a task with the above-mentioned characteristics is illustrated here.

> An e-commerce firm sells products to customers worldwide and the sale is denominated in various foreign currencies. The accounting system does not automatically convert the sale to the local currency. Therefore, as part of the daily process, a finance professional is tasked to extract the previous day's sales amount in foreign currencies, convert it to the local currency (Singapore dollars) based on the previous day's exchange rate, and generate a summary report in Excel. The specific steps that a finance professional perform daily are outlined in the following flowchart.



While the above process can be clearly defined and follows a logical path, repeating it for multiple foreign currencies daily can be time-consuming and prone to errors. Therefore, the characteristics of the process make it an ideal situation to deploy an RPA bot.

Additionally, one of the value prepositions of RPA is that they can be layered onto existing information technology (IT) systems and act as an interface bridge across different systems. This can sometimes be a more feasible and economically viable option for organisations, rather than upgrading their underlying enterprise system to incorporate new requirements. In fact, it was reported by Gartner that 94 per cent of their customers indicated that "task automation involving integration of different applications was the most important use case for them."[2]

Key advantages of RPA

An RPA can outperform humans when performing structured, rule-based and repeatable tasks. When deployed to a suitable business processes, there is potential to reap strong benefits in terms of efficiency and effectiveness.

Some of the key advantages are listed here.

RPA robot

- Quicker
- Can work 24 hours if necessary
- Constant productivity
- Will not make errors (depends on its algorithm)
- Will not become bored
- Lower staff costs
- Can be easily scalable
- Does not fall sick

Human

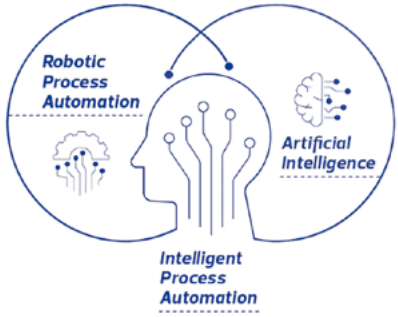
- Much slower
- Cannot work non-stop
- Productivity varies through the day
- Might make errors
- Might become bored if the work is repetitive and mundane
- Potentially expensive
- Not easily scalable
- Might fall sick

[2] *Gartner: Critical Capabilities for Robotic Process Automation (1 September 2020)*

What is intelligent process automation?

While RPA can deliver significant benefits to organisations, it can only perform routine and predictable tasks. Tasks that require cognitive ability and subjective decision-making are beyond the capabilities of an RPA.

Increasingly, RPAs are integrated with other emerging technologies and techniques such as optical character recognition (OCR), artificial intelligence (AI), machine learning (ML) and natural language processing (NLP) to expand their capabilities. This evolved version of RPA is called Intelligent Process Automation (IPA) and can perform more complex tasks requiring some form of cognitive ability or high-level thinking.



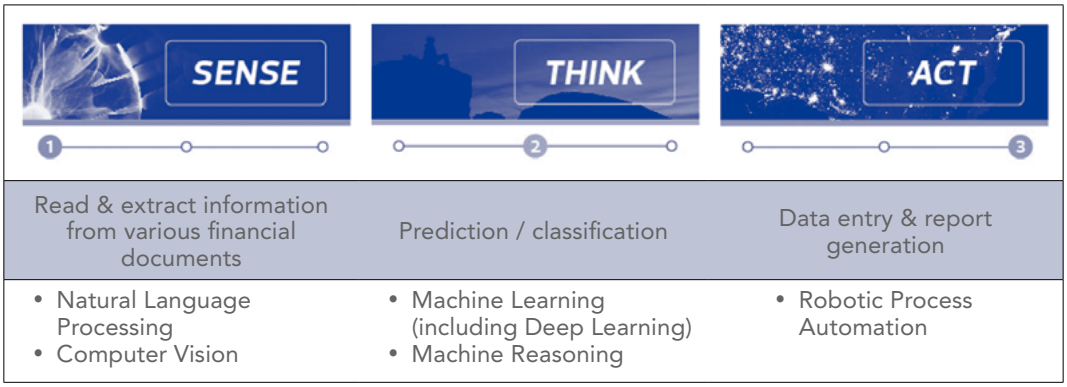
Source: RSM Singapore

How can IPA enhance the finance function?

Data entry is one of the most common and time-consuming tasks in finance. For example, staff need to read and extract key information from various documents such as invoices, bank statements, purchase orders, sales orders and bills of lading. They have to enter the data into a structured table and extract general ledger data from the accounting systems to perform reconciliation and generate reports.

IPA has the potential to transform this process for greater operational efficiency, thereby allowing staff to focus on high-value areas while the IPA is running. IPA can analyse scanned copies of various financial documents and apply both OCR and NLP techniques to read and extract relevant information. Using the data, the IPA can apply AI to predict the document type and nature of the extracted fields (e.g. company name, dollar amount, currency, item type, etc.). Subsequently, the IPA application can input the processed data into a structured database and/or generate reports.

A common workflow of an IPA application in the finance function is shown below.



Source: RSM Singapore

IPA ideally shifts the needle from process benefits to intuitive experiences and higher order outcomes, ultimately making it more human-like.

Examples in finance

Extraction and analysis of data from investment management reports

Case study 1: ***Extraction and analysis of data from investment management reports***	
Pain-points	A company holds multiple investment portfolios managed by different asset managers. Every month, each asset manager will issue a monthly statement in PDF format. To analyse the data, the finance staff extract the data from the PDF report into a spreadsheet that is more structured and accessible. The staff will then analyse the data, perform some calculations to derive metrics such as closing balance, realised gains and losses, and fair value gain. Due to the manual nature of the process, it can take up to three man-days each month to perform the tasks. In addition, the process is also prone to human errors during data transcription and analysis.
Solutions	An RPA bot was developed to extract the data from the PDF investment reports, process it into a structured format, and perform analyses such as calculation of the portfolio's closing balance and realised profit and loss. The RPA can also compare the calculated metrics of investment performance with market benchmarks. The output of the analysis can then be loaded onto a business intelligence tool for reporting purposes.
Benefits	With the RPA in place, it can greatly boost the efficiency of the financial and accounting operations by more than 90 per cent. More resources can be devoted to higher-value tasks that drive better business decisions.

Finance reconciliation and report generation

Case study 2: *Finance reconciliation and report generation*	
Pain-points	The reconciliation process for the finance function of a company involves matching the information across several diverse data sets from operational systems, payment systems (point-of-sales) and bank statements. This process can be tedious and time-consuming. Next, the company has many customers who can pay via different modes such as internet banking or cash payment. For payments made through internet banking, although the customers have been informed to use the invoice number as the transaction reference code, a large proportion do not fully adhere to the instructions. This makes it difficult for the finance staff to match each of these transactions with the invoice numbers recorded in the accounts receivables. Additionally, as the company's suppliers issue invoices in hard copies, finance staff needs to sight the information from the hard copy documents and then enter them into their database for tracking and reporting purposes. When a business operates several outlets that requires monthly reports to be generated for each of the outlets, the challenge is then amplified multiple times.
Solutions	An IPA integrates with the various IT systems (finance, payment, and operational). It reads all the input files, cleanse the data to an appropriate data structure, perform reconciliation of all the information, identify all variances and output the results of the analysis in nicely and clearly formatted reports. As the transaction descriptions from the bank statement do not always match the invoice number from the accounts receivable, an intelligent feature called "fuzzy matching" is layered onto the RPA. With the new feature, it is possible to match descriptions that do not match exactly but contain fair amounts of similarity. Additionally, advanced techniques and technologies such as OCR and NLP can automate the conversion of a scanned document image to readable text, and subsequently extract key information such as invoice number, amount, date, item description and supplier name.
Benefits	The IPA with OCR and NLP capabilities can boost the efficiency of the monthly reporting process and the accuracy of their reports. The tedious and time-consuming task of reconciliation, report generation and formatting can be delegated to the RPA. As the staff only needs to validate the reports, this can free them up for potentially higher-value work such as interpreting the information and making data-driven recommendations. As the business grows, the number of reports required will increase proportionately. However, with IPA, there will be no discernible impact on the time taken to perform the same process since it can be easily scaled.

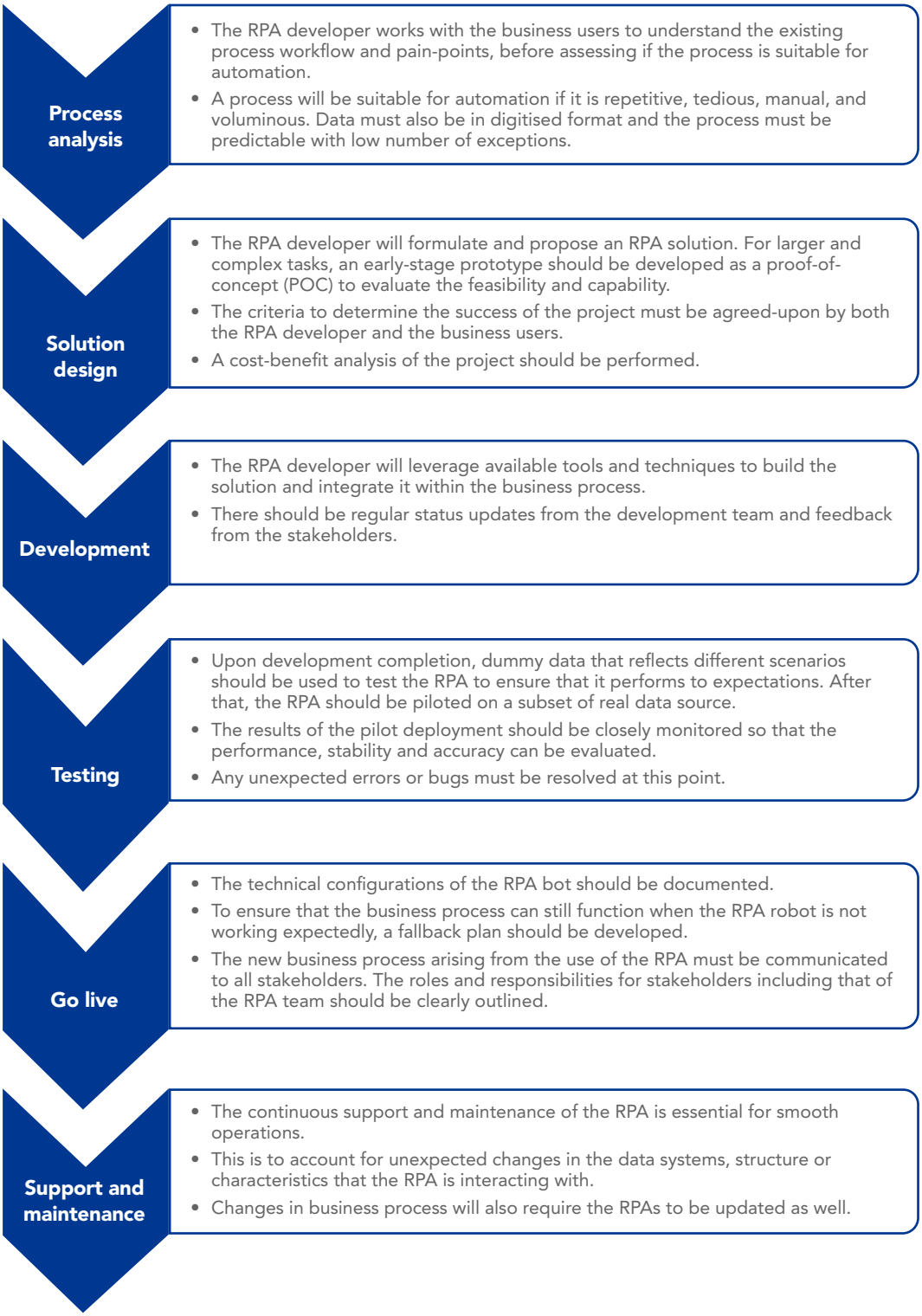
Automated document classification

Case study 3: *Automated document classification*	
Pain-points	The finance function requires a considerable amount of information to be verified. During this process, financial documents from various parties may be requested. The process to receive and manage these documents as well as to reconcile the information and then archive the documents digitally is manual, tedious and time-consuming.
Solutions	A centralised document management system (DMS) that incorporates the use of several IPA bots is developed to automate parts of the process. After scanning physical copies of the documents, the system can perform automated classification of the document type, digitally archive the document based on the document type, and then send an email notification to the respective departments when new documents are received. The IPA solution incorporates the following technical features: - Computer vision and AI techniques to classify the documents based on the bank logo, document layout, or any other image identifiers in the document; - OCR to convert the image to textual information; - NLP to extract key information from the textual information - RPA to use the information derived from the previous steps to archive the documents in a desired location on the server.
Benefits	With the deployment of the DMS with IPA capabilities, the finance team can easily access the financial documents and focus efforts on information verification rather than data collection, entry and management.

Key stages of RPA development process

For organisations looking to deploy RPAs across their business processes, having a robust development process will enhance the probability of success. The development process, when communicated clearly to the RPA developers (either in-house or commercial vendors) and the various stakeholders, will allow a consistent way of conducting the project, and ensure that key stages and deliverables are tracked, managed and evaluated appropriately.

A simplified RPA development process



Tools

The selection of RPA software is an important consideration whenever an organisation decides on automating their business processes.

Although each RPA bot essentially comprises a set of instructions or codes, software tools have evolved to a stage where RPA bots can be developed and deployed without coding. This has given rise to the term "citizen developer" – a non-professional RPA developer. A citizen developer can rely on software with intuitive graphical user interface to instruct the actions they want the bot to perform and the software will automatically translate it into computer code.

While it can be considerably easier to deploy RPA bots today, organisations should consider the following points when choosing an RPA tool:

1. **Compatibility with existing system**
   Some RPA tools only support Windows operating system whereas some are limited in their ability to interact with desktop application.
2. **Stability of the tool**
   Stability of the RPA tool is one of the most important consideration. When the tool is unstable and results in unexplainable errors, it is difficult to resolve the issues. This can result in unnecessary delays during development.
3. **Development and operation cost**
   RPA tools that are freely available under open-source licenses incur low to no software cost. However, such tools are commonly code-based and may require investment in a dedicated RPA engineer. On the other hand, some commercial RPA tools require no coding. However, these tools may require more investment upfront, such as a software licensing fee. An organisation should evaluate the overall cost in the long-term and align any decisions with the company's digital transformation roadmap.
4. **Flexibility in customising features**
   A good tool will have the flexibility to allow RPA developers to create customised functions to perform more complex or specialised tasks.

Advice for organisations

With the availability of RPA software in the market, it is not difficult to begin using RPA. However, some organisations have found it challenging to find success in their RPA strategies.

To improve the success of an RPA strategy, organisations can consider the following factors:

1. **Management support**
   Technological solutions address business challenges and must be aligned to business objectives. Therefore, management support is critical to the success of such technological solutions. Without management's emphasis and alignment of the projects to address business objectives, it is difficult to convince process owners and stakeholders of the value of the project which will in turn limit the success of the project.

2. **Involvement of process owners and stakeholders**
   A common reason why RPA projects fail is because they are sometimes considered an IT project. However, technological solutions are designed to address business needs. Therefore, before commencing an RPA project, process owners and stakeholders must be consulted on business processes. Active involvement from the process owners and stakeholders will help the project to execute smoothly as requirements can be gathered and considered at an early stage, solutions can be tested regularly, and errors can be rectified in a timely manner.

3. **Manage expectations**
   As with most emerging technologies, there can be unnecessary hype and unrealistic expectations on RPAs to fully automate human actions with perfect reliability and zero errors. Despite the best efforts of the process owners in defining the problem and that of the RPA developers in designing the solution, this is not always the case. It is practically infeasible to build in rules to address all possible scenarios. Additionally, as RPA interfaces with other data or systems, changes in the data structure or systems may also lead to new errors that could not be predicted. Constant maintenance of the RPA bots will be required. The limitations of RPAs should be clearly articulated upfront so that stakeholders do not prematurely term the RPA as a failure if it does not perform up to expectations at the beginning.

4. **Start small, think big**
   It is tempting to design and deploy an RPA that addresses many parts of a business processes all at once. For inexperienced organisations, this can compromise the success of the RPAs because the use case can be overly complex. Therefore, a more reliable strategy would be to break down the project into several phases and prioritise those with higher impact and lower complexity to maximise the return on investment.

5. **Close monitoring, continuous improvement**
   Even well-designed machines can fail at times. It is similar for RPA bots. Therefore, it is important that the usage of RPA bots be logged and monitored regularly. In the event of failures, it is important to notify stakeholders promptly so that they can execute their fallback plan and to avoid significant impact to business operations. To avoid repeated failures, the systems should be regularly maintained and improved. As RPAs rely on largely pre-defined scenarios, any changes to the process will require the RPA to be updated as well. Organisations should be prepared to devote resources to support, maintain and add new features to the RPA after initial development.

6. **Managing employees' concerns on job security**
   Some employees might be reluctant to the idea of automation due to fears that they will soon become obsolete. Therefore, it is important that organisations manage this human aspect of automation, beyond the technical considerations. While many employees can enjoy the benefits of automation if they can transit to high-value work, some may have to be retrained and upskilled to fit other jobs. Regardless of the organisational strategies, open communication between the management and employees on the benefits and impact of automation on jobs will be important.

Checklist

To help organisations decide on whether to deploy an RPA or not, the following questions can help kick-start the thought process.

Management

- Is the RPA solution aligned with business objectives?
- Are there resources to develop and maintain the RPA?
- Is the project worth the investment considering the cost-benefit analysis?
- Have you considered the potential risks and impact to your business?

Process owners

- Have you identified any pain points from your processes?
- Has your process been streamlined and digitalised?
- Does your process satisfy most if not all the criteria for an ideal RPA project?
- Will there be any major changes to the processes within the short term?
- Within the process, is there any area requiring high-level subjective decisions?
- Have you performed the cost-benefit analysis?

RPA Developer

- What is the complexity of the business process to be automated?
- Have you considered all possible scenarios that might not be addressed by the RPA?
- Have you assessed the suitability of the various tools and technologies to perform the task?
- Have you provided feedback on the development effort and cost of the project to the process owner?

Concluding remarks

In the era of the fourth industrial revolution, the wave of digital transformation and intelligent automation is sweeping across industries and job functions. The COVID-19 pandemic has also accentuated the need for organisations to be sustainable and competitive in the long-term. RPAs have the potential to provide a cost-efficient digital workforce that is able to perform repetitive and time-consuming tasks with greater efficiency and accuracy as compared to a traditional human-powered workforce.

With complementary emerging technologies such as OCR, AI and NLP, RPAs can even perform tasks that require some form of judgement and decision-making.

The potential applications of IPA cover many business processes, such as finance, human resources, procurement, IT and audit. Businesses should keep abreast of such technological developments that could enhance the efficiency, accuracy and effectiveness of their processes.

In the aftermath of the COVID-19 pandemic, the business risks of not adopting such technologies could be potentially high, as the organisation starts to lag behind its competitors in terms of costs, efficiency and speed.

The authors would like to thank colleagues from RSM Singapore who have contributed to this work. The authors would also like to express gratitude to collaborators from CPA Australia and Singapore Management University for inviting us to participate in this publication.

ERP AND CLOUD TECHNOLOGY: POWERING FINANCE FOR THE NEXT ERA OF GROWTH

CHAPTER 7

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Key points for finance executives:

- Building a digital core should be an immediate priority, with platforms playing a central role.
- CFOs must adopt a "cloud-first" mindset and encourage its adoption across the enterprise.

Introduction

Beyond its devastating impact on global health, COVID-19 poses an ever-evolving set of challenges for organisations, from new ways of working, industry disintermediation and the localisation of supply chains, to changing consumer behaviour and demand. Many have responded by accelerating digital investment, often compressing decade-long transformation agendas into a fraction of that time.

As they adapt to changing circumstances, build greater resilience, and create new streams of revenue, the performance gap between those with a strong digital core and those without has widened. Accenture's research shows that organisations with strong digital and technology cores are able to attain 2-3 times the revenue growth of their competitors, further expanding the Digital Achievement Gap[1]. However, it is not enough to simply invest in digital. What is needed is agile, responsive, and scalable technology that can rapidly create new insights and identify next-best actions.

With visibility to data across the enterprise, and an understanding of enterprise risk and operational resilience, CFOs have become key to this process. In Accenture's global survey of more than 1,300 finance executives, 79 per cent of CFOs said the pandemic had amplified their role as a strategic partner to the CEO and the business[2]. Some 72 per cent said they had the final say on the appropriate technology direction for the enterprise[3].

Uniquely positioned to both recognise the growth potential and monitor costs of digital investments that cut across the enterprise, CFOs have the opportunity to drive the technology investments that enhance their organisation's competitive advantage and enable them to keep pace with the speed at which change is taking place.

As they do this, it is critical that they understand the role of a strong digital core and the power of the Cloud in being able to drive enterprise-wide cost optimisation and to fuel innovation and growth. This will allow them to provide the strategic steer that charts the way forward – not just for the finance function but for the organisation as a whole.

[1] *Accenture Technology Vision 2021, Leaders Wanted: Masters of Change at a Moment of Truth, 5*

[2] *Accenture Global CFO Research 2021, CFO Now: Breakthrough Speed for Breakout Value, 4*

[3] *Accenture Global CFO Research 2021, CFO Now, 7*

Key Takeaways for the Finance Executive: Act Now, Act Decisively

#1: Building a digital core should be an immediate priority, with platforms playing a central role

As technology investments get pushed to the top of the agenda, there is a window of opportunity which, if used properly, could set the organisation up for sustained value creation moving forward.

Legacy systems have interoperability issues with new technology and can be increasingly costly to maintain. Meanwhile, platform providers like SAP, Oracle and Workday now offer process standardisation and automation, centralised data governance and even analytics capabilities built into the core platform. With an intelligent enterprise platform at the core, the rest of the organisation – including its operating model – can pivot more rapidly.

This holistic approach of platform providers is enabling organisations to tackle multiple issues around inefficiency in operations or inadequacy of data architecture and reporting, while accelerating the adoption of leading industry processes, the generation of business insights, and the development of a highly skilled workforce.

For CFOs, this means enabling their organisations to improve the bottom line by driving operational efficiency, while seeking out new sources of growth and value.

#2: Cloud is no longer just an ambition, but a mandate

Given the volatility of the current global economy, the need for technology that is adaptable and scalable has become more important than ever. Already a mindset shift can be observed in the market from hosting enterprise platforms on-premise, to moving to the cloud. In fact, a report by Gartner predicts that global spend on public cloud services will grow 18.4 per cent in 2021 to US$309.4 billion, compared to 6.1 per cent growth from 2019 to 20204.

The benefits are indisputable. In addition to improving operational efficiency and providing near real-time insights for decision-making, moving to the cloud unlocks further value by enabling easy integration with other platforms and peripheral systems, which enables more targeted customer offerings and capabilities to the workforce. It can also reduce overall IT costs by converting large capital expenditure spend to multi-year operating expenses, freeing up working capital to fund growth opportunities. Additionally, there is the flexibility of being able to scale up or down based on fluctuating demand or consumption, at a time of high market volatility.

To unlock this value, CFOs must adopt a "cloud-first" mindset and encourage its adoption across the enterprise.

From Platform to Cloud: The Empowered CFO

As a strategic partner across the C-Suite, the CFO's role today is vastly different from that of their predecessors. Broad industry shifts have given rise to complex and often conflicting priorities and expectations for businesses, and expanded responsibilities in the CFO's traditional role as the economic guardian of the enterprise to new roles as the architect of business value and catalyst of digital strategy.

[4] *Gartner, "Gartner Forecasts Worldwide Public Cloud End-User Spending to Grow 18% in 2021", November 17, 2020*

A robust digital core and cloud strategy can help organisations address these challenges, and ultimately empower the CFO in their critical roles.

Figure 1: Challenges the CFO must contend with[5]

- As **economic guardian**, the CFO must effectively lead a finance function that is operationally efficient and focused on predictive insights
- As the **architect of business value**, the CFO will drive purposeful collaboration across the enterprise to leverage untapped opportunities in the end-to-end value chain
- As the **catalyst of digital strategy**, the CFO will be equipped to tap the power of data to chart new courses for the enterprise and discover new revenue streams

Economic Guardian

As economic guardians empowered by platform and cloud technologies, CFOs possess the tools that will allow them to unlock the full benefits of digital transformation, most significantly, the ability to generate predictive insights. With that comes the ability to identify new sources of value from customers, channels and products.

In Accenture's 2018 survey, CFOs predicted that by 2021, 45 per cent of traditional finance tasks would be automated. The 2021 survey showed that some 60 per cent of finance tasks are now automated[6], revealing a faster than anticipated digitalisation of the function. Yet fewer than half (43 per cent) have used advanced financial modelling in the past two years to identify future risks and opportunities[7], missing out on the transformational potential of technology.

[5] *Adapted from Accenture's The Cloud-First CFO: How cloud can create sustainable value for finance and the enterprise, 3*

[6] *Accenture Global CFO Research 2021, CFO Now, 10*

[7] *Accenture Global CFO Research 2021, CFO Now, 10*

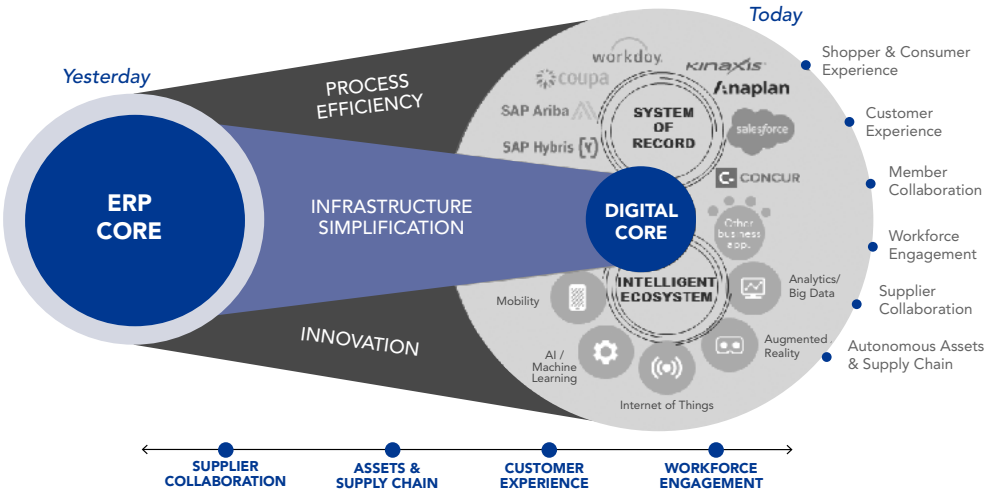
Particularly in this time of variability and uncertainty, CFOs need to prioritise forecasting and scenario modelling. Value chain volatility demands shorter cycle times for reporting and planning, and CFOs must be prepared to provide guidance at short notice. The CFO of today needs to be able to make sense of the vast amounts of data being collected across the enterprise, and turn this into meaningful, actionable insights. They need to build – and continually update – digital competencies within the finance workforce to enable them to use the tools, technology and data that will allow them to do this. These realities are already becoming evident in the workplace – Accenture's research shows that while traditional finance and accounting skills remain important, CFOs are prioritising data exploration and analysis (41 per cent), scenario planning and horizon scanning (38 per cent), innovation (37 per cent) and storytelling (34 per cent)[8] in their workforces.

Even as they train their focus further into the future, CFOs must also ensure the continued profitability and the overall financial health of the organisation. Today, this includes preserving liquidity in an economic environment that favours easily accessible cash reserves and increasing the efficiency of the finance function as costs come under increasing scrutiny – among them, the cost of technology obsolescence and aging infrastructure.

How Platform and Cloud Technology can help:

- The number and sophistication of capabilities built into the core of ERP systems today mean organisations can streamline their systems landscape and technical architecture. This means that organisations have access to best of breed systems with ease of integration through pre-built APIs and higher functional value with potential lower costs.

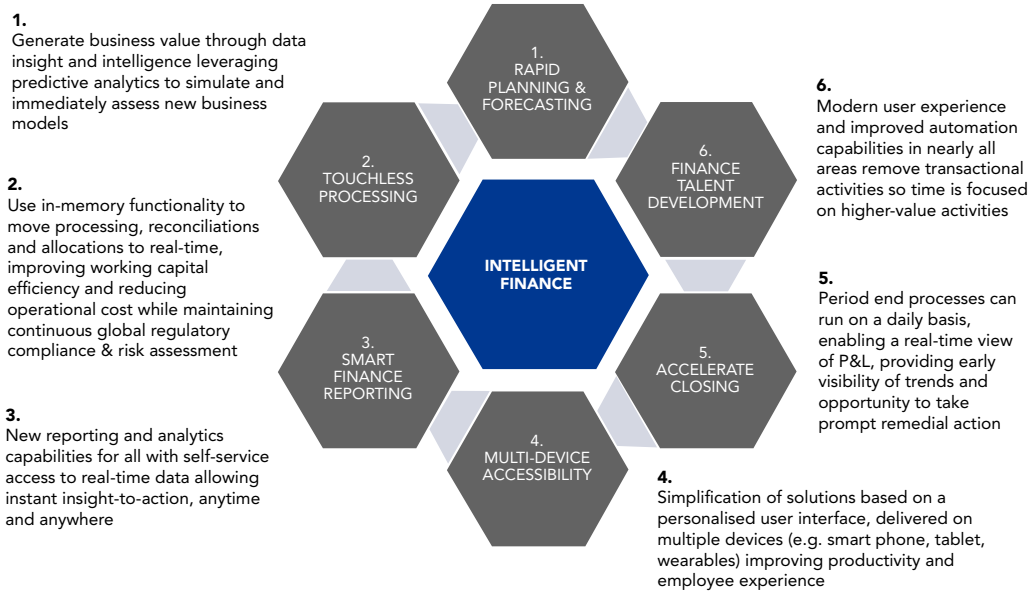
Figure 2: Evolution of the Digital Core



[8] *Accenture Global CFO Research 2021, CFO Now, 13*

- As organisations adapt their operating models to a COVID-changed world, Enterprise Resource Planning (ERP) systems accelerate the changes implemented, while driving the adoption of new ways of working.
- For the CFO, newer editions of platform technology offer enhanced reporting and analytics capabilities, with self-service access to real-time data and near real-time generation of insights, helping the finance function to increase its attention on future-focused action planning.
- Moving finance processing, reconciliations and allocations to real-time also improves working capital efficiency and reduces operational costs, while system-enabled controls ensure global regulatory compliance and management of risks.

Figure 3: What Intelligent Finance looks like



- The connectivity, automation and leading practices incorporated into SaaS and cloud-based ERP and financial applications break down data silos to give CFOs visibility across the organisation and access to rich datasets that can be applied to predictive scenario modelling. By using this centralised data store to feed cross-functional insights, tune algorithmic models and achieve a more granular level of forecasting, CFOs can anticipate changes in the market, and respond to potential threats and opportunities.
- CFOs can leverage real-time data, combining treasury workstation or treasury management systems with predictive analytics and artificial intelligence/machine learning (AI/ML) to run liquidity impact scenarios and better manage cash.
- With lower implementation and running costs, cloud-based systems and data platforms help CFOs strike a balance between efficiency and liquidity. Additionally, as an operational expenditure spread over several years, the shift to cloud-based systems allows CFOs to preserve financial liquidity in the medium-term.

Architect of Business Value

In addition to driving transformation and digitalisation from within the finance function, CFOs are increasingly providing strategic inputs on how value creation in the organisation can be accelerated.

To identify and unlock pockets of value, CFOs must establish visibility across the value chain. This includes close collaborations with the various C-Suite functions and using cross-enterprise insights to inform strategic decision-making. Accenture's study found that 86 per cent of CFOs have already increased the frequency and scope of collaboration within the C-suite[9]. High performing finance executives have gone a step further, putting into place formal structures where stakeholders from across the organisation come together to ideate improvement and innovation opportunities[10].

In this role, CFOs must manage increased data as well as demands for more performance insights across more dimensions, more quickly, all of which require higher processing power. Despite the increasingly complex processes involved, the pressure to mitigate any loss of profits remains. Finally, CFOs need to orchestrate the cross-enterprise partnerships that will support innovative business models that reflect the new realities of the market, from blurring industry boundaries to disintermediation.

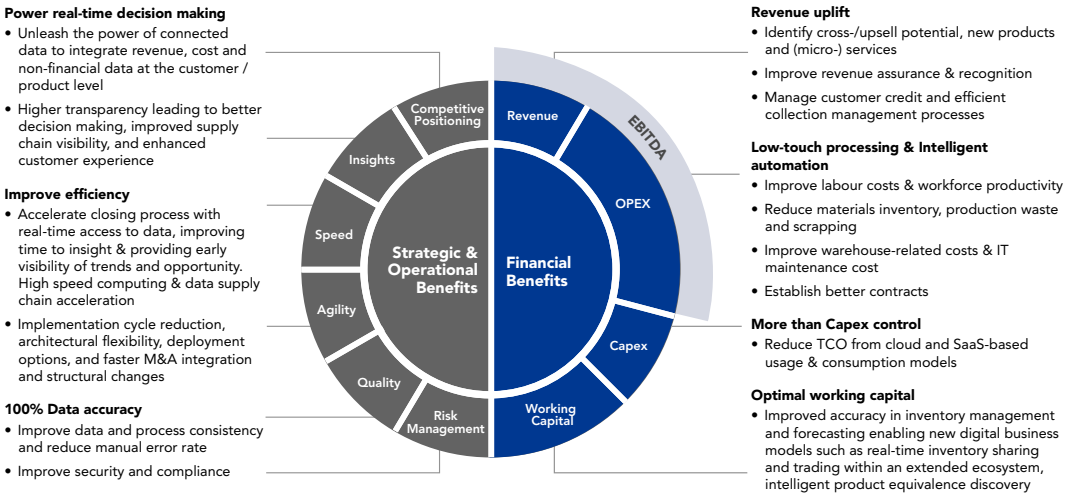
How Platform and Cloud Technology can help:

- Consolidating the different types of data, including operational or non-financial data from external systems, onto the digital core powers real-time decision making, delivers improved efficiency, and uplifts revenue, among other benefits (see Figure 2). ERP systems provide a common platform on which this can be done.
- By leveraging the cloud, CFOs act as "sensors at the edge" of the enterprise, consolidating data streams from across geographies and functions, and running AI-based models to derive insights in real time. Public, private or hybrid cloud solutions can be used, depending on privacy and security requirements.
- Cloud-based process-mining solutions can connect directly to source systems to provide ongoing monitoring of end-to-end value chains and business processes. As CFOs strive to create customer value, this allows friction and the root causes driving errors, deviations and value leakage to be uncovered in real time.
- With merger and acquisition (M&A) activity, ventures and partnerships on the rise, the cloud provides for better, faster and cheaper integration. Using a cloud-based ERP, parent companies can create a simpler plug-and-play architecture. Alternatively, the merged or acquired entity can create a flexible two-tier architecture as it transitions to the parent company or the new merged entity. By allowing standard leading practice to be adopted immediately, cloud-based applications further accelerate the integration process. For both organisations, this means less spent on maintaining older higher-cost systems as the entities migrate off legacy systems.

[9] *Accenture Global CFO Research 2021, CFO Now, 16*

[10] *Accenture Global CFO Research 2021, CFO Now, 17*

Figure 4: Strategic, Operational and Financial Benefits of Platform and Cloud Technologies in Finance



Catalyst of Digital Strategy

As first movers into the digital space, CFOs have a wealth of experience in everything from platform transformation and shared services to business intelligence applications and the cloud[11] to tap on as they lead the digital transformation of their organisations.

Amid widespread disruption, they ensure alignment between business and IT strategies, as well as compliance with new regulatory requirements and market demands. CFOs also play a critical role in ensuring return on investments in the new digital business models that have replaced traditional channels made obsolete by market disruptions.

Accenture research highlighted three areas of focus for CFOs as catalysts of digital strategy: new business models, data and privacy, and environmental, social and governance (ESG)[12].

In Accenture's survey, 41 per cent of CFOs said that they had been driving new business models, while 40 per cent said they had been revising digital strategy holistically. Findings from Accenture's CXO pulse survey suggest the pace will only pick up: almost three-quarters (72 per cent) of the CFOs surveyed said their organisations would have to completely rethink their processes and operating models to develop resilience to disruptions[13].

Concern over data and privacy breaches was the most cited barrier in the way of CFOs reaching their potential as drivers of strategic change. However, only 28 per cent were actively managing risk through data security to a meaningful degree. In the area of ESG, 68 per cent of respondents said that ultimate responsibility for ESG performance within their organisation rested with finance[14].

[11] *Accenture Global CFO Research 2021, CFO Now, 20*
[12] *Accenture Global CFO Research 2021, CFO Now, 19-22*
[13] *Accenture Global CFO Research 2021, CFO Now, 20*
[14] *Accenture Global CFO Research 2021, CFO Now, 22*

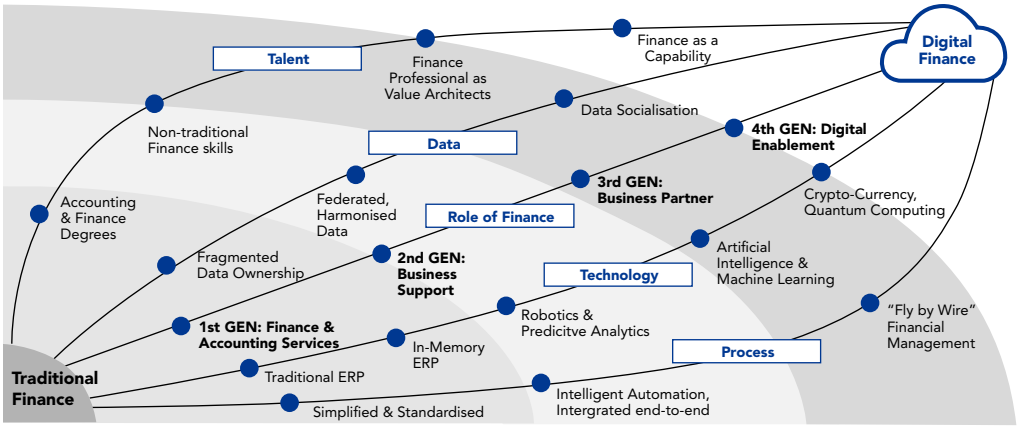
How Platform and Cloud Technology can help:

- Organisations would be hard pressed to match the physical and digital security of hyper-scaler cloud providers such as Amazon Web Services (AWS), or the investments they pour into this core area of their business. Cloud-based software applications also benefit from more frequent security patching. For organisations, leveraging the cloud translates into end-to-end security, particularly critical at a time when remote work is becoming increasingly common.
- With cloud infrastructure being three to four times more energy efficient than corporate data centres, leveraging public cloud infrastructure significantly lowers an organisation's carbon footprint. Those migrating to hyper-scaler cloud architecture can breathe even easier knowing that almost all hyper-scalers use renewable energy sources to power their infrastructure.
- Finance executives are optimally positioned to facilitate their organisations' consumption of cloud-enabled data as a primary method for generating profit. Insights and intelligence derived from data and predictive analysis allow them to simulate and quickly assess new business models. They could also maximise the value of data by treating it as an asset.

The Cloud Journey

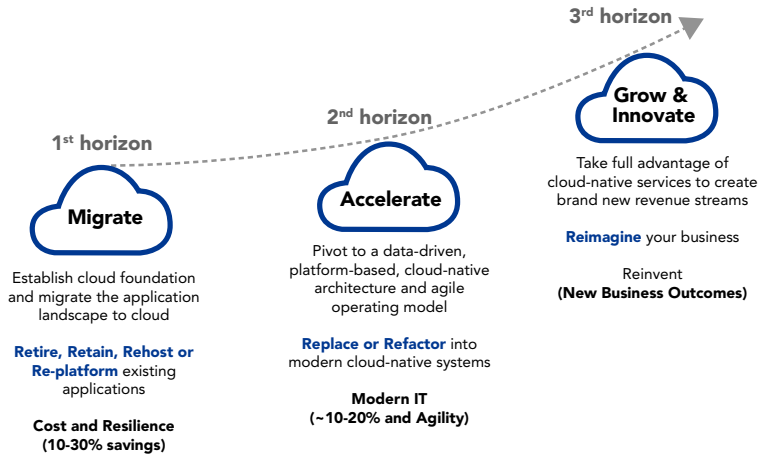
For CFOs, the journey to cloud can be read against the backdrop of the journey to digital finance. Having the right technology and data structures in place expedites transformation across the various elements of the operating model, for instance, process and talent, and ultimately elevates the entire function. As architects of business value, CFOs are best placed to take the organisation on the same journey.

Figure 5: Getting to Digital Finance



In order to have the greatest impact, CFOs should prioritise those capabilities that support operational efficiencies, growth and innovation, and develop them in parallel. This integrated, strategy-led approach delivers greater impact from cloud investments, and quickly. By contrast, a linear approach focusing on completing IT cost optimisation before moving to greater sources of value may mean waiting three to five years to realise the full benefit of their cloud investment. Accenture has developed a dynamic approach that moves business across three horizons to help them determine the direction of their cloud journeys. These horizons are not sequential or mutually exclusive.

Figure 6: Three Horizons of Cloud Adoption[15]



Migrate:

In the Migrate horizon, organisations free up capital by moving workloads to the cloud. While the applications and business logic remain unchanged, they run more efficiently in an as-a-service environment. For example, by moving its 200 servers to AWS, a global processed foods company gained the flexibility to scale its IT operations, allowing it to keep pace with consumer expectations and meet changes to demand across its yearly business cycle. Without the need to make significant investments in ongoing operating expenditures, it has also been able to shift funds to fuel its growth strategy.

Accelerate:

In the Accelerate horizon, organisations begin moving enterprise systems such as ERP and customer relationship management (CRM) to versions offered natively in a Software-as-a-Service (SaaS) model or applications run on a cloud platform. While the Migrate horizon was about simply migrating applications, this horizon is about automating and transforming processes, and leveraging applied intelligence, especially if enterprise data is available.

From moving enterprise systems on cloud, companies begin to move their core business systems onto the cloud, for example, for supply chain management or financial technology. They transform processes and adopt new ways of working that leverage AI and automation. Accenture has worked with a major global retailer to migrate its existing SAP estate to Microsoft Azure, and transform its application and infrastructure management services environment to drive innovation and growth. Besides gaining end-to-end visibility into business operations in the finance area, the client now has a dynamic and agile platform for its enterprise solutions, can quickly scale its resources up or down as needed, and can put the cost savings achieved towards growth.

Grow & Innovate:

In this third horizon, companies can pilot and scale new business models at speed. They have the data-driven insights that fuel rapid innovation and allow them to reimagine their business. While there are very few companies operating in this horizon, many are well on their way.

[15] *Adapted from Accenture's The Cloud-First CFO: How cloud can create sustainable value for finance and the enterprise, 6*

For one leading financial and retail technology company, shifting corporate IT systems to the cloud and improving global processes and applications for its 22,000 employees across more than 100 countries will unlock some US$50 million of incremental savings through 2023. Leveraging digital automation tools and empowering a more agile and customer-focused workforce will also improve business productivity, consolidating operations and performance and enabling investment in innovation and growth opportunities.

Getting started

Even as organisations accelerate investments in agile and scalable technology, and research continues to link these investments with better business outcomes, it is important to recognise that the impact and value of technology investment is determined by a number of factors.

Transitioning to the cloud is not a simple technology upgrade. It is a strategic imperative that requires a fundamental shift in an organisation's operating model. To succeed, cloud migration must be matched with new roles, metrics, data governance rules, and requires a clear alignment of business needs and IT within the organisation.

A genuine cloud transformation also starts with a cloud-first culture that begins at the top and then permeates the entire organisation. The shared appreciation of cloud and the data it yields is what accelerates change. Without the buy-in from the rest of the C-suite and the enterprise, organisations would struggle to realise the full potential and benefits that cloud-based platform technology can offer.

A series of "quick wins" go some way in demonstrating value, for instance, when an organisation pilots a single data set and then builds on its success, or when smaller applications that need minimal re-platforming are successfully migrated to the cloud.

Commit to Complete Transformation

The risk of being left behind while cloud-first competitors move ahead is significant and inevitable, and this has only been exacerbated by the ongoing pandemic. Leaders have pushed ahead with rapid digital acceleration, widening the gap between leaders and laggards, and pulling the rug from under the feet of those taking a "wait-and-see" approach. To respond to a radically changing world, enterprises must prioritise technology innovation - and now. Small pilots and incremental scaling no longer serve business interests.

CFOs need to steer away from linear cost reductions and commit to complete cloud transformations in order to secure their competitive advantage and ability to be disruptors in their industries. It is only by capturing the full potential that technology currently offers that finance leaders can unleash insights critical to driving value across the enterprise and secure the future of their businesses.

TAX IMPLICATIONS OF DIGITAL TRANSFORMATION – A SINGAPORE PERSPECTIVE

CHAPTER 8

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Key points for finance executives:

- There is a whole slew of tax and non-tax incentives available from Singapore to support business digitalisation efforts.
- Digital transformation introduces novel tax implications and challenges, both locally and globally.
- Singapore's tax rules will certainly change as the global economy continues to shift towards more digitalisation.
- It is critical for businesses to keep abreast of tax changes that may apply to them as they embark on their digitalisation journey.

Introduction

The transition from a more conventional or traditional economy to a digital economy has been afoot and moving swiftly and furiously not just in Singapore but globally. This transition has been further accelerated by COVID-19. With the rapid transformation of the global economy, the way businesses in Singapore have been run has also undergone similar transformation. This should not come as a surprise. Indeed, businesses that resist such change would inevitably be left behind.

With this paradigm shift, tax policies would necessarily have to change as well, involving considerations as to whether such policy should merely follow digital transformation, or whether it should also act as a driver for such shift. Owing to increasing worldwide connectivity and globalisation, this change would have to take place at both domestic and international levels. Digitalisation, being a major force of change, has elicited tax policy responses from governments all over the world. Singapore is of course no exception. Hence, in 2019, Ms. Indranee Rajah, Minister in the Prime Minister's Office and the Second Minister for Finance and Education, very aptly highlighted this:[1]

"Digitalisation is a major force of change, bringing in its wake many novel business models. Blockchain technology, artificial intelligence, augmented reality – these are some examples of technological advances in recent years, which are transforming how we live, work and play. But that is not all there is to digitalisation. The digitalisation of the economy has also elicited tax policy responses from governments all over the world, in the domains of direct and indirect taxation."

For example, in Singapore, the goods and services tax (GST) was recently extended to overseas digital services (colloquially known as the "Netflix tax") from 1 January 2020. The reverse charge mechanism was activated on 1 January 2020 for business-to-business supplies of imported services, the first time the mechanism had been used since being introduced into tax law in 1994. These rules were necessary in order to ensure that the collection of taxes continues to evolve together with rapid changes in the economy.

In this chapter, we will examine some of the key tax issues both in the local and international context as a result of digital transformation.

[1] *Opening address at the International Fiscal Association Singapore Branch – Tax Academy 2019 Digital Tax Conference, 4 October 2019*

Key tax issues in the Singapore context

1. General income tax treatment

Before going into some of the tax changes as a result of the transition to a digital economy, it would be useful to briefly recap the general income tax treatment in Singapore.

Singapore adopts a territorial basis of taxation. Generally, any income accruing in or derived from Singapore, or is received in Singapore from outside Singapore, would be subject to income tax in Singapore. This can be contrasted with other taxation systems, such as a worldwide tax system, where residents of a particular jurisdiction are taxed on their worldwide income regardless of where the income is sourced.

Even with the shift to a digital economy, the basic charging principle for income tax in Singapore remains unchanged. As such, even if businesses (whether local or foreign) were carried on in a digital space, income earned by such businesses would be subject to Singapore income tax as long as it is considered to have accrued in or been derived from Singapore.

2. Income tax considerations for e-commerce

While the basic charging principle described in the previous section does not change for digital businesses or e-commerce, the Inland Revenue Authority of Singapore (IRAS) has published certain administrative guidance[2] on how it considers whether income from e-commerce transactions accrues in or derives from Singapore.

The IRAS has indicated that where business income is concerned, it would employ the broad principle of "operations test" to determine whether the income accrues in or derives from Singapore so as to be liable to Singapore income tax. Essentially, if the business operations giving rise to the income are carried out in Singapore, the IRAS would consider the income derived from those operations to be sourced and thus taxable in Singapore. It is important to note that whether business operations are carried out in Singapore is largely a question of fact and degree. Further, specifically where e-commerce transactions are concerned, the IRAS would also look into the business model, the extent of operations and locality of the business in order to ascertain whether the income from the e-commerce transactions are derived from Singapore.

The IRAS has also provided various examples of e-commerce business models and how they would be treated for income tax purposes. Notably, some of the factors that the IRAS will take into account when determining whether e-commerce business operations are carried out in Singapore include the following:

(i) if the company has a website, where the website is hosted and the activities undertaken by the website;

(ii) if the company has a branch, where the branch is located and the activities undertaken by the branch; and

(iii) where the company completes the obligations of each e-commerce activities, such as:
   a. sourcing for contents;
   b. promotion and advertising efforts;
   c. maintaining the currency of information for the website;
   d. answering queries on its goods and services;
   e. receiving payments for purchases;
   f. delivery of goods; and
   g. provision of after-sale services.

[2] *IRAS e-Tax Guide, "Income Tax Guide on E-Commerce" dated 18 Aug 2015*

It is therefore important for e-commerce companies to properly understand their business models before it can be determined whether their income from e-commerce transactions would be subject to income tax in Singapore.

Additionally, certain payments made by residents or permanent establishments in Singapore to foreign companies may be subject to withholding tax. The issue of withholding tax will be examined in the subsequent section.

3. Withholding taxes

It is difficult to enforce the collection of taxes from persons who are not known to be tax resident in Singapore and do not have any presence in Singapore. As such, as is typical of many tax systems, withholding tax is the method of collection employed to collect taxes from such persons. This method of collection serves to impose a legal obligation on residents or permanent establishments in Singapore to withhold tax from certain payments they make to foreign persons at the appropriate rate and account for such payments to the IRAS.

Withholding tax only applies to certain payments. Such payments include:

(i) interest, commission, fee in connection with any loan or indebtedness;

(ii) royalties;

(iii) payments for the use of or the right to use scientific, technical, industrial or commercial knowledge or information or for the rendering of assistance or service in connection with the application or use of such knowledge or information;

(iv) management fees; and

(v) rent or other payments for the use of any movable property.

As mentioned above, such payments, if made by residents or permanent establishments in Singapore to persons not known to be tax resident in Singapore, may attract withholding tax. In particular, what may be relevant for e-commerce businesses are payments for software and payments for the use of or the right to use information and digitised goods. Such payments may attract withholding tax depending on how they are characterised.

The IRAS adopts the rights-based approach for characterising such payments.[3] This approach characterises a payment based on the nature of the rights transferred in consideration for the payment, and draws a distinction between the transfer of a "copyright right" and a "copyright article".

A transaction involves a "copyright right" if the payer is allowed to commercially exploit the copyright, such as by reproducing, modifying or adapting and distributing the software, information or digitised goods. In contrast, in a transaction involving a "copyright article", the rights transferred are limited to those necessary to enable the payer to operate the software or to use the information or digitised goods, either for personal consumption or within the payer's business operations. Generally, payments that do not involve the transfer of the "copyright rights" embedded in the goods will be considered as payments for "copyrighted articles".

While payments for the partial transfer of "copyright rights" would generally be considered as royalties and subject to withholding tax, payments for "copyrighted articles" would be characterised as business income (and not royalties) and will not be subject to withholding tax.

[3] *IRAS e-Tax Guide, "Rights-Based Approach for Characterising Software Payments and Payments for the Use of or the Right to Use Information and Digitised Goods" dated 8 Feb 2013*

It would be important for businesses to understand the characterisation of payments they make to foreign businesses, especially payments for software, information or digitised goods, in order to determine their withholding tax obligations.

4. GST considerations in general for e-commerce businesses

Generally, the same GST rules apply for supplies of goods and services in Singapore, whether they are made physically or via an electronic network. Thus, as long as the goods or services are supplied in Singapore, even if the goods or services are supplied through electronic means, GST would generally apply.

For physical goods supplied (i.e. sold) over an electronic network, whether GST has to be charged would depend on the destination of delivery of the goods. Similarly, for digital services supplied over an electronic network, whether GST has to be charged would also generally depend on where the customers are located.

Depending on the exact nature of the business, different and more directed GST considerations may apply. For example, the IRAS has published administrative guidelines for the advertising industry and also for web-hosting services and server co-location services.

5. GST on imported services

One of the key tax changes as a result of the digitalisation of the economy was the imposition of GST on imported services from 1 January 2020, which was introduced after an extensive consultation among the Ministry of Finance (MOF), the IRAS, businesses as well as industry associations that began as far back as May 2017 when the IRAS released consultation papers on the topic.[4]

This implementation ultimately took place via the overseas vendor registration regime (OVR) for business-to-consumer[5] (B2C) supplies of imported digital services and the reverse charge mechanism for business-to-business[6] (B2B) supplies of imported services. Some of the reasons for the imposition of GST on imported services are to seek to achieve parity between local suppliers and overseas suppliers in light of the digital economy, and also to defend Singapore's current revenue base from being eroded as more transactions move online. This change was expected to generate additional tax revenue of about S$90 million per year, according to Mr. Lawrence Wong, then Second Minister for Finance:[7]

"With the digital economy, it has become increasingly common for services to be supplied by overseas suppliers, without the need for the suppliers to establish a presence within Singapore. We welcome this development, as it allows businesses and consumers to have access to services from overseas suppliers readily. ***But at the same time, we must ensure that our tax rules are updated, such that both imported and local services are treated on a level playing field and accorded the same GST treatment.*** *This means that GST ought to apply on local consumption of services, irrespective of whether the service is supplied in Singapore or from abroad."*

[4] *Deputy Prime Minister Heng Swee Keat, Speech in Parliament on Measures to level playing field for GST-registered local suppliers vs non-GST registered overseas suppliers, 6 November 2017*

[5] *B2C supplies refer to supplies made to non-GST-registered persons*

[6] *B2B supplies refer to supplies made to GST-registered persons*

[7] *Second Reading of the Goods and Services Tax (Amendment) Bill 2018, 19 November 2018*

As a result of the imposition of GST on imported digital services (if the relevant conditions are met), overseas suppliers of digital services such as Netflix and Spotify had to charge GST on their digital services provided in Singapore. While the scope of such digital services is not exhaustive,[8] the IRAS has provided some examples of these digital services (Exhibit 1).[9]

Exhibit 1
List of included and excluded digital services

INCLUDED Digital Services	**EXCLUDED Digital Services**
Supply of digital products	*Cross-border telecommunication services*
Supply of software programs	*Advertising services on intangible media platform circulated wholly outside Singapore*
Supply of images, text and information and making available of databases	*Professional services involving human intervention, even if advice is provided by electronic means*
Supply of music, films and games	
Supply of distance teaching via pre-recorded medium or e-learning	
Supply of electronic data management services	
Services providing or supporting a business or personal presence on an electronic network	
Supply of search-engine and automated helpdesk services	
Listing services for the right to put goods or services for sale on an online market or auction house	
Supply of live streaming services where there is no interaction with the content provider	
Advertising services on intangible media platform circulated wholly in Singapore	
Support services performed, via electronic means, for arranging and facilitating the completion of transactions, which may not be digital in nature	

While these are the current rules in place for the OVR regime, it was announced in Budget 2021 that the OVR regime would be extended to B2C imported non-digital services (such as live interaction with overseas providers of educational learning, fitness training, counselling and telemedicine) and B2C low-value goods which are imported via air or post from 1 January 2023. This change is intended to further ensure a level playing field for local businesses to compete effectively, and also to ensure that Singapore's GST system remains fair and resilient as the digital economy grows.

[8] "Digital services" means any service supplied over the Internet or other electronic network and the nature of which renders its supply essentially automated with minimal or no human intervention, and impossible without the use of information technology

[9] *IRAS e-Tax Guide, "GST: Taxing imported services by way of an overseas vendor registration regime (Second Edition)" dated 26 Aug 2019*

Under the reverse charge regime, certain GST-registered businesses are required to account for GST on some services they procure from overseas suppliers as if they were the supplier themselves. Similar to the extension of the OVR regime, the reverse charge regime would also be extended to B2B imported low-value goods from 1 January 2023.

The introduction of these relatively new regimes reinforces the point that Singapore's tax rules do not remain stagnant and become outdated. While these regimes took some time to be implemented, the current rapid growth of the digital economy has also been a catalyst for further tax changes in Singapore as Singapore also seeks to protect its shifting revenue base.

6. Digital tokens and initial coin offerings

With the digitalisation of the economy, another area that has generated much interest and traction has been the use of digital tokens, as well as initial coin offerings (ICOs). The Singapore tax implications brought about by businesses employing the use of digital tokens and ICOs started off being relatively uncertain. However, the IRAS has since published administrative guidance on this area.

Digital tokens

There are various considerations that are relevant in determining the income tax liability arising from the use of digital tokens. The income tax treatment generally depends on the nature and use of digital tokens being transacted. A brief summary of the income tax treatment of digital tokens is presented in the table below (Exhibit 2).[10]

Exhibit 2
Income tax treatment of digital tokens

Type of digital token	Income tax treatment
Payment token	Payment token is regarded as an intangible property. Consequently, transactions involving the use of payment tokens as payment for goods or services are viewed as barter trade and the value of goods or services transferred should be determined at the point of transaction.
Utility token	The use of a utility token to exchange for goods or services is unlikely to create an income subject to tax on the user at the point of exchange. It may, on the other hand, give rise to a deductible expense subject to usual deduction rules.
Security token	The taxability of the return derived from a security token depends on the nature of the return, for example, whether it is in the form of interest, dividend or other distributions.

In addition, the general income tax treatment would apply for businesses that trade in digital tokens. Businesses that buy and sell digital tokens, or mine and trade digital tokens, in the ordinary course of their business would be subject to income tax on their profits from doing so. Whether gains from the disposal of digital tokens are considered trading gains (as opposed to capital gains, which are non-taxable and generally arise from the disposal of digital tokens held for long-term investment purposes) would depend on certain factors often labelled as the "badges of trade", which include:

[10] *IRAS e-Tax Guide, "Income Tax Treatment of Digital Tokens" dated 9 Oct 2020*

- intention at the time of acquisition;
- length of ownership;
- frequency of similar transactions; and
- circumstances surrounding the disposal.

ICOs

An ICO refers to the first issue of a digital token to the general public, and is commonly used as a method by businesses to raise funds for new projects. Such new tokens are commonly issued in exchange for other digital tokens or fiat currency. Over the last few years, Singapore has become a hotbed for ICOs.

The income tax implications on ICOs generally depend on the rights and functions of the tokens issued to investors, which in turn also depend on the type of digital token. A summary of how the IRAS would treat ICO proceeds from an income tax perspective is contained in the table below (Exhibit 3).[11]

Exhibit 3
Income tax treatment of ICO proceeds

Type of digital token	Income tax treatment of ICO proceeds
Payment token	Generally, the ICO company is treated to be carrying on a trade of trading in payment tokens and the tokens will be treated as its trading stock. Hence, the proceeds from the issuance of payment tokens will be taxable. Nonetheless, as the issuance of payment tokens through an ICO is uncommon, an examination of the case facts may be required to determine the tax treatment. The proceeds would be taxed at the point of issuance. This is on the consideration that so long as there is a willing buyer and willing seller, it is possible to trade in the payment token that has been issued.
Utility token	The issuance of a utility token comes with an obligation for the issuer to provide a service in the future. Hence, the proceeds from the issuance represent consideration for the payment of the service, and is taxable, being revenue in nature. Generally, it is necessary for the ICO company to complete the development of a service platform, before it can fulfil its performance obligations. As such, the proceeds from the issuance of utility tokens is regarded as a form of deferred revenue. The proceeds would be taxed when the performance obligation is fulfilled (e.g. services are performed, goods delivered).

[11] *IRAS e-Tax Guide, "Income Tax Treatment of Digital Tokens" dated 9 Oct 2020*

Security token	The issuance of security tokens confers certain contractual rights and economic entitlements to the investor. These can be akin to those conferred to an equity shareholder, a debt holder or other holder of the securities or investment assets/instruments. In this respect, the proceeds from the issuance of security token are akin to those from the issuance of securities or other investment assets and are thus capital in nature and not taxable. The ICO company will not be taxed on the proceeds at the point of issuance. However, general income tax rules/ withholding tax obligations apply to the dividend, interest and other distributions derived by the investor/token holder.

GST

With effect from 1 January 2020, supplies of digital payment tokens are no longer subject to GST. Previously, the supply of virtual currencies was treated as a taxable supply of services and would ordinarily be subject to GST.

However, supplies of other tokens that do not fall within the definition of "digital payment tokens" would still generally be regarded as taxable supplies of services (unless they are specifically exempt), and would be subject to GST.

Key tax issues in the international context

While the previous sections have considered some of the key tax issues surrounding the digitalisation of businesses in the local context, there are certain issues that arise on the global front. This is mainly due to the fact that the transformation to a digital economy is not merely constrained to what happens within our borders – digitalisation also paves the way for new foreign entrants to enter Singapore waters and vice versa. Some of the international tax issues arising from the digital economy are highlighted in the following sections.

1. Permanent establishment

Simply put, a permanent establishment refers to a taxable presence in a particular jurisdiction. A permanent establishment can take the form of a fixed place of business through which the business of an enterprise is wholly or partly carried on. If a foreign business is considered to have a permanent establishment in a particular jurisdiction, such foreign business would generally be subject to tax in that jurisdiction to the extent that profits are attributable to the permanent establishment. This tax treatment is often determined by an applicable double taxation agreement which that particular jurisdiction has with the relevant foreign jurisdiction in which the enterprise is resident.

While the concept of permanent establishment is not new, the international shift to a digital economy has brought about new issues in this regard. For example, jurisdictions have to deal with questions such as whether a website or a server[12] would constitute a permanent establishment.

[12] *A server refers to a device upon which e-commerce applications may be sited or run from to allow e-commerce to take place, and would usually include the computer hardware and its operating and basic application software (IRAS e-Tax Guide, "Income Tax Guide on e-Commerce" dated 18 Aug 2015)*

Singapore is no exception. With regard to the presence of a server in Singapore, the IRAS has indicated that the mere presence of a physical server in Singapore will not amount to trading in Singapore. The IRAS would look through the server, which merely acts as a communicator tool, to the extent of business in Singapore to determine if an entity is trading in Singapore (or has a permanent establishment in Singapore) such that their business income is liable to Singapore tax.[13] As for a website, to the extent that the website merely facilitates the conduct of e-commerce transactions, the website should not be considered a permanent establishment.

2. The OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting

As a result of the increased connectivity of businesses transnationally, multinational enterprises have been exploiting gaps and mismatches between the tax systems of different jurisdictions. This in turn has led to domestic tax base erosion and profit shifting (BEPS), which deprives jurisdictions of tax revenue that they would ordinarily have been entitled to.

The Organisation for Economic Co-operation and Development (OECD) finalised its 15-point action plan to combat BEPS in 2015. The key action plan of relevance would be action 1, which deals with the tax challenges arising from digitalisation. The international tax challenges arising from digitalisation mainly stem from the waning effectiveness of current international income tax rules, which are largely based on physical presence "nexus" rules. These rules could not effectively deal with the digital economy, which involves operations without physical presence, and focuses on intangible assets and the essentiality of data.[14] While the new technologies arising from digitalisation have radically transformed businesses, they have also facilitated new methods of international tax avoidance, which the OECD seeks to combat.

Following numerous developments in this area, a consensus-based solution comprised of two pillars was devised. Pillar 1 focuses on nexus and profit allocation, and reviews rules that determine where and how much corporate profits are allocated and taxed. Under Pillar 1, there is a proposed re-allocation of taxes from where value is created to where consumers are (i.e. the market and user jurisdictions). Pillar 2 focuses on the imposition of a global minimum tax regardless of where businesses operate in.

Singapore, as a member of the Inclusive Framework on BEPS, has also been participating in the discussions and work done in this arena. In this respect, Singapore advocates that the consensus-based solution has to be based on the following two principles:

(i) the international tax framework must continue to support global economic growth and innovation; and

(ii) any changes in tax rules must continue to give room for jurisdictions to pursue their own policy mix appropriate to their circumstances and developmental needs.

Hence, Ms Indranee Rajah gave these remarks in 2019:[15]

"As detailed in the OECD's 2018 interim report, some view the value creation concept as being inadequate in fully capturing the characteristics of highly digitalised businesses. For these newer and highly digitalised business models, Singapore supports a robust discussion on how improvements can and should be made to the existing tax framework to reflect the new forms of value creation. The pillar of value creation underpinning the current international tax framework should continue to stand strong, by incorporating new features."

[13] *IRAS e-Tax Guide, "Income Tax Guide on e-Commerce," section on FAQs*

[14] *https://www.oecd.org/tax/beps/beps-actions/action1/ (accessed on 29 April 2021)*

[15] *Opening address at the International Fiscal Association Singapore Branch – Tax Academy 2019 Digital Tax Conference, 4 October 2019*

Therefore, Singapore continues to support a value-creation approach as it is believed to align tax outcomes with businesses' deployment of economic substance and economic realities. Further, Singapore believes that every government should be allowed to determine how much it spends and how it raises revenue to finance such spending, as the optimal revenue mix for one jurisdiction may not work for another.

Ultimately, to some extent, whether the policies arrived at by the OECD will affect how businesses are taxed in Singapore would depend on whether such policies are incorporated in Singapore domestic tax legislation. Given that these developments are fairly recent, it remains to be seen how our local tax laws will continue to evolve together with the international tax developments in this area. In May 2021, then Minister for Finance Mr Heng Swee Keat stated in Parliament that any adjustments to Singapore's tax system will be guided by three principles – to abide by internationally agreed standards, to safeguard Singapore's taxing rights, and to minimise compliance burden for businesses, especially small and medium enterprises (SMEs).[16] As a start, the IRAS has indicated that if unilateral taxes incurred by foreign jurisdictions to address the tax challenges of digitalisation are imposed in the form of turnover taxes (not income taxes), they are generally deductible against income taxable in Singapore. Examples of such taxes include India's equalisation levy and the United Kingdom's digital services tax.[17]

More recently, the Group of Seven[18] (G7) reached a landmark deal to reform the global tax system to make it fit for the global digital age. Similar to the two-pillar approach devised under the OECD/G20 Inclusive Framework on BEPS, the agreed measures by the G7 include allocating more taxing rights to jurisdictions where consumers are located, and backing a global minimum corporation tax rate of at least 15 per cent for multinational companies. It is currently unclear (and therefore uncertain) whether these specific proposals will be accepted by the larger international community, including the member jurisdictions of the OECD/G20 Inclusive Framework on BEPS. In this regard, Minister for Finance Mr Lawrence Wong indicated that it is too early to say what the proposed changes will mean for Singapore. However, he also stated that the MOF and the IRAS will make the necessary changes to Singapore's corporate tax system as and when a global consensus is reached on the framework, in close consultation with businesses and tax professionals. He further said that Singapore will continue to ensure that its tax system is compatible with international norms while managing the administrative and compliance burden on businesses.[19]

Should foreign jurisdictions adopt the policies described above, it would be crucial to see how this would interact with Singapore's domestic legislation and the numerous double taxation agreements Singapore has concluded.

[16] *Minister for Finance Heng Swee Keat, Speech in Parliament on Impact of US proposal for global minimum corporate tax rate on Singapore, 10 May 2021*

[17] *https://www.iras.gov.sg/irashome/Businesses/Companies/Working-out-Corporate-Income-Taxes/Business-Expenses/Tax-Treatment-of-Business-Expenses--A---H-/ (accessed on 29 April 2021)*

[18] *The Group of Seven is an informal group of seven of the world's advanced economies, comprising Canada, France, Germany, Italy, Japan, the United Kingdom, the United States and the European Union*

[19] *Gabrielle Andres, "Singapore will ensure its tax system is compatible with international norms while managing burden on businesses: Lawrence Wong", CNA, 8 June 2021*

Singapore's commitment to the digital economy

Undoubtedly, Singapore has shown that it is committed to the digital transformation of its economy. This is evident from the support the government has provided in recent years, in the form of both non-tax and tax incentives. Some of the incentives introduced over the years by the government are reflected in the table below (Exhibit 4).

Exhibit 4
Certain incentives introduced for digital transformation

Incentive	Year of launch	Description / Key features
SMEs Go Digital Programme	2017	• Mainly administered by the Infocomm Media Development Authority (IMDA). • Sector-specific Industry Digital Plans provide SMEs with a step-by-step guide on the digital solutions to adopt and relevant training for employees at different stages of growth. • Helps SMEs to get started with foundational digital solutions. • Provides platforms where SMEs can participate in B2B and B2C e-commerce platforms to sell overseas without a need for physical presence. • Provides digital consultancy to SMEs. • Access to a one-stop web application where SMEs can assess their digital maturity and digitalisation needs. • Enterprises can enjoy up to 80 per cent co-funding support to adopt more advanced solutions to deepen their capabilities, strengthen business continuity measures and build longer term resilience.
Productivity Solutions Grant	2018	• Administered by Enterprise Singapore (ESG). • Provides funding support of up to 80 per cent of the qualifying cost for the adoption of pre-scoped IT solutions, equipment and consultancy services that improves productivity, aligned to the respective industry roadmaps.
Tech@SG Programme	2019	• Jointly administered by the Economic Development Board (EDB) and ESG. • Eligible companies (that have a digital/technology offering as their core business) may receive up to 10 new employment passes (EPs) over two years for foreign employees who will be hired as part of the companies' core team in Singapore, as well as coverage for the first renewal of each new EP obtained under the programme.
Enterprise Grow Package	2020	• Aims to help enterprises identify business needs, adopt pre-approved digital technologies and take the first steps to enter new markets. • Launch of the GoBusiness platform, a single touchpoint for enterprises to transact with the government digitally. • Expansion of the SMEs Go Digital Programme. • Enhancement of the Market Readiness Assistance grant.

Digital Leaders Programme	2021	• Developed jointly by IMDA and ESG. • Enables promising local companies to integrate digital technology into their core business strategy to develop new capabilities and business models, and capture new growth opportunities. • Provides support over two years for up to 70 per cent of the qualifying cost in three areas: - building an in-house core digital team; - charting a digital roadmap; and - developing Proof of Concepts for new markets and customer segments.

Aside from these non-tax initiatives for businesses to undergo digital transformation, there are also certain tax incentives and benefits for digitalisation. Some of the tax benefits are briefly described in the table below (Exhibit 5).

Exhibit 5
Certain tax incentives and benefits for digitalisation

Tax benefit / Incentive	Description / Key features
Capital allowances for intellectual property (IP)	• Companies can claim writing-down allowances on capital expenditure incurred to acquire IP rights for use in their trade or business. • To claim such writing-down allowances, the legal and economic ownership of the IP rights would have to be transferred unless approval for waiver from legal ownership has been granted by the EDB. • A company will be allowed to make an irrevocable election to claim the writing-down allowances over a 5-year, 10-year or 15-year period (on a straight line basis).
IP Development Incentive	• Administered by the EDB. • An approved company is eligible for a reduced corporate tax rate of either 5 per cent or 10 per cent on a percentage of qualifying IP income derived by it during the incentive period. • Qualifying IP income includes royalties or other income receivable as consideration for the commercial exploitation of qualifying IP rights. • The concessionary tax rate will increase by 0.5 per cent at regular intervals.
Approved Royalties Incentive	• Tax exemption or a concessionary tax rate may be granted on the withholding tax imposed on approved royalties, technical assistance fees or contributions to research and development costs made to a non-resident person for providing cutting-edge technology and know-how.

Deductions for research and development (R&D)	• Companies who incur R&D expenditures and are the beneficiaries of R&D activities may claim R&D tax deductions. • The amount of tax deductions or whether the deductions are allowable depends on various factors, such as whether the R&D work is related to the taxpayer's trade, whether the taxpayer undertakes R&D work directly, outsources the R&D work, participates in a cost-sharing agreement, and where the R&D work is carried out.
Double tax deduction for internationalisation scheme	• Companies may claim automatic double tax deduction on qualifying expenses incurred of up to a specified expenditure cap on certain qualifying activities. • The qualifying activities include virtual trade fairs approved by ESG product or service certification approved by ESG, overseas advertising and promotional campaigns, and advertising in approved local trade publication. • Companies may also apply to ESG or Singapore Tourism Board for approval to claim double tax deduction on (i) qualifying expenses incurred on qualifying market expansion and investment development activities that exceed the specified expenditure cap; or (ii) expenditure incurred for other qualifying activities.

The non-tax and tax incentives described above are some of the initiatives that the Singapore government has undertaken to support the digitalisation of its economy, which have been well received by businesses. For example, to date, more than 63,000 SMEs have adopted digital solutions with the support of the SMEs Go Digital Programme, with about 40,000 of them signing up in 2020 alone.[20] More than 15,000 SMEs have also applied for and received support from the Productivity Solutions Grant.[21]

The ongoing review of such incentives is important as well to ensure that these incentives stay relevant and that businesses are provided a healthy environment to grow as Singapore's economy continues to shift, especially with the lapsing of the productivity and innovation credit scheme a few years ago. In order to continue to cater to digital transformation, perhaps more targeted incentives can be considered for emerging sectors such as artificial intelligence, blockchain and the Internet of Things.

Conclusion

Digitalisation is here to stay. As former Minister for Trade and Industry, Mr Chan Chun Sing pertinently stated in a speech at the Future Economy Conference & Exhibit 2020, "digital transformation will truly unlock for us, the world as our hinterland and market. But that is if we make the right moves now, harness the power of digital to grow our businesses, drive our economy recovery, redefine our competitiveness and relevance to the world". In 2020, Singapore had also entered into the Digital Economy Partnership Agreement, which establishes new approaches and collaborations in digital trade issues, promotes interoperability between different regimes and addresses the new issues brought about by digitalisation, which further cements Singapore's resolve for digital transformation.

[20] *Minister for Communications and Information S Iswaran, Ministry of Communications and Information Committee of Supply Debate, 2 March 2021*

[21] *Minister for Trade and Industry Chan Chun Sing, Future Economy Conference & Exhibit 2020, 22 September 2020*

With a whole slew of government initiatives and incentives supporting Singapore's digitalisation efforts, businesses should be well placed in their efforts to adopt and embrace digitalisation. However, digital transformation would introduce novel tax implications and challenges, both locally and globally. Singapore's tax rules would certainly change as the global economy continues to shift towards more digitalisation. It is therefore critical for businesses to keep abreast of the tax changes that may apply to them as they embark on their digitalisation journey.

DIGITAL FORENSICS INVESTIGATIONS

CHAPTER 9

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Key points for finance executives:

- New digital tools and discovery methods complement existing forensically-sound approaches to forensic investigations.
- Digital technologies deliver intelligible visualisation with comprehensive information to digital forensics investigators for further interrogation and analysis.
- It is important for investigators and accounting professionals to have broad familiarity with the digital options available to them when conducting and managing an investigation.

Introduction: How digital transformation affects digital forensics

We are not only surrounded by data and technology but, in the modern day, it also influences our lives, whether we like it, know it, or not. Smartphones, tablets, and Internet of Things (IoT) devices such as smart fridges and smart watches; people are heavily dependent on digital devices. Technology has changed the world while also reshaping daily activities to the extent that now people cannot imagine living a day without their digital devices. This demand has accelerated the already-in-place digital transformation movement.

Rewinding a few decades, technology was not a commodity. Not all households and businesses had access to the internet, let alone IoT devices. Despite the many positive impacts that technology has had on our lives, it has also opened the floodgates to online criminal activities[1].

In recent years, as digital transformation gathered momentum, the volume of digital data grew at an exponential rate. As an example, there is approximately 128.8 billion business emails sent and received every single day[2]. The proliferation of digital devices in society has presented opportunities for modern criminals, resulting in substantial changes in criminal behaviour such as intellectual property theft, fraud, identity theft, cyber-attacks, and many others. Due to this ever-changing technological environment and, as a result, more complicated and technology-oriented frauds, crimes, and disputes, forensic accountants are increasingly using advanced forensic technology tools[3]. Organisations, their management, and finance professionals are swamped by the amount of data in the digital universe and increasingly struggle with more data than their analysis tools can handle. This very clearly impacts the profession of accounting and digital forensics.

Within the context of digital forensics investigations – investigations involving data sourced from digital sources such as computers, servers, mobile devices, the cloud, and so on – there are clear signs that courts and regulators have become more accepting of, and savvy to, technology such as data analytics and artificial intelligence[4]. These tools support investigations that enhance the fact-finding processes. However, the challenge remains for senior management and those responsible for finance functions – particularly when dealing with high-stakes investigations: **how does one uncover the facts, save time and money, while still being able to provide a workable solution?**

1 *https://www.csa.gov.sg/singcert/publications/global-local-ransomware-trends-2020-q1-q3*

2 *https://www.campaignmonitor.com/blog/email-marketing/2019/05/shocking-truth-about-how-many-emails-sent/#:~:text=This%20data%20set%20shows%20that,receives%20121%20emails%20per%20day*

3 *https://www.globenewswire.com/news-release/2020/05/13/2033087/0/en/The-digital-forensics-market-was-valued-at-USD-4170-0-million-in-2019-and-it-is-expected-to-reach-USD-7410-9-million-by-2025-registering-a-CAGR-of-10-03-during-the-forecast-period-.html*

4 *Rio Tinto PLC v. Vale S.A., 306 F.R.D. 125 (S.D.N.Y. 2015) McConnell Dowell Constructors (Aust) Pty Ltd v Santam Ltd & Ors (No 1) [2018] VSC 734*

A key differentiator for investigators today is the ability to employ "augmented" investigation methodologies associated with technologies that can elevate their capabilities to analyse data effectively, while still maintaining the true and trusted digital forensic processes that make the practice defensible in a courtroom, to a regulator, or other government body. This has driven the evolution of digital forensics investigations discussed in this chapter.

Challenges faced in digital forensics investigations

With the plethora of data in various forms, digital forensics investigations face the following challenges:

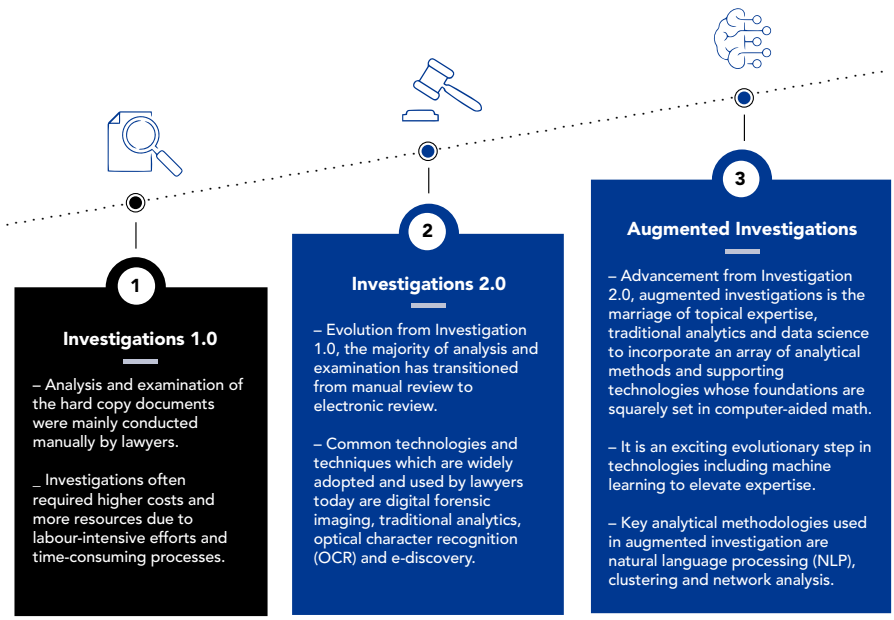
1. **Data Volumes:** There is an exponential growth in data volumes from an expanding variety of sources. Collecting, processing, storing, and analysing vast amounts of data can be a complex procedure.
2. **Disparate Data Sources:** Data relevant to an investigation may exist in different systems (some of them proprietary), geographies and departments, as well as sources external to the organisation. Information silos may hinder investigations as correlations and potential patterns may not be uncovered.
3. **Available and Accurate Data:** Data relevant to an investigation, both current and historical, may not be adequately captured and stored. The quality of the results from any analysis is only as good as the quality of the data and inputs that feed that analysis.
4. **Data Protection and Privacy Regulations:** Privacy law applies to organisations collecting, using, or disclosing personal data in Singapore, Australia, and globally. In cross-border investigations, laws in one jurisdiction may not be consistent with disclosure regulations in other jurisdictions[5].
5. **Encryption:** If the data is not readable or accessible, it is clearly not usable in an investigation.

"With the digital transformation movement, the challenges faced in digital forensics are the enormous volume of data, encryption and access to data, the complexity and multitude of data sources, different types and classifications of data, privacy, and new types of crimes brought on by digital transformation."

[5] *http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.149.5392&rep=rep1&type=pdf*

Approaches, tools, and techniques in augmented investigations – digital forensics

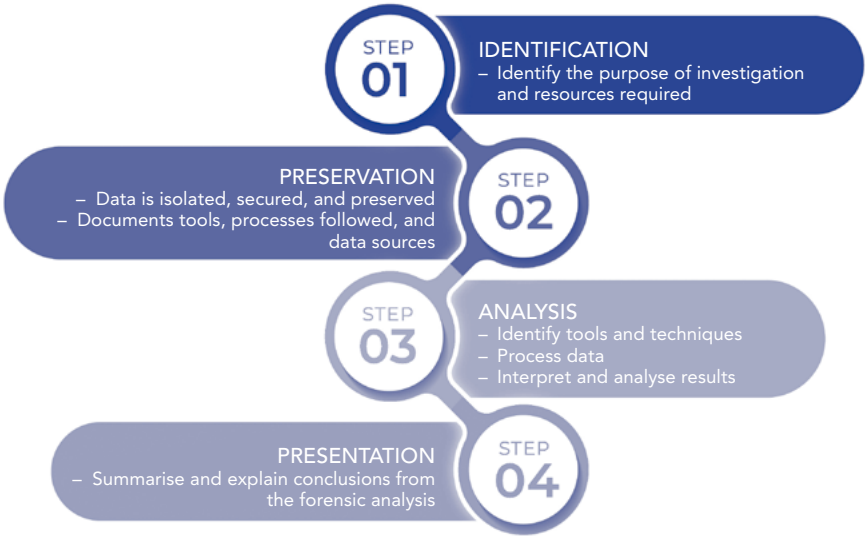
Exhibit 1: The evolution of investigations



Investigations 1.0: In the 1980s and 1990s, the traditional type of investigation involved a review of paper correspondence, a review of hard-copy accounting records, bills of lading, invoices, cheques and cheque registers, and a review of hard-copy accounting records. Whilst the volume of data was not large compared with today's standards, more time and effort from manual resources was required. It also involved fewer false positives.

Investigations 2.0: Approximately 15 to 20 years ago, FTI Consulting started to see a shift with investigations now involving forensic collection and analysis of electronic emails and chats. Investigations also started including an electronic review of accounting/transaction records such as trading data, accounting, payments, as well as Microsoft Excel spreadsheets with thousands of transactions. This was predominantly rule-based (e.g. 'inclusive' searches to build a review population of documents and transactions, in combination with 'exclusive' searches, to remove clearly irrelevant documents and transactions from a population), which involved less manual resourcing, however, still necessitated much time and effort. At the same time, the volume of false positives increased as data volumes increased.

Exhibit 2: Digital forensic investigative process



"Augmented" Investigations: To supplement modern-day investigations, i.e. Investigations 2.0, 'augmented' investigations now involve forensic collection and analysis of communications from social media, chat, instant messaging, forum data, emails, call logs, GPS locations, calendar items, WIFI network connects, the dark web, and so on. It also involves accounting/transaction records and linking these multiple systems, as well as other large-scale databases, involving potentially billions of records and transactions.

An augmented investigation is the combination of topical expertise, traditional analytics and data science to incorporate an array of analytical methods and supporting technologies whose foundations are squarely set in computer-aided mathematics.

The natural consequence of the big-data craze and digitalisation, where data is just data regardless of form, and analytics-consumers' expectations have been set – data should deliver insight. This is an exciting evolutionary step in the ability of methods and technologies, including machine learning, to elevate expertise.

It is critical to note that Augmented Investigations are not revolutionary, but rather, evolutionary; the proven forensic processes are supplemented with varying options and approaches, such as those provided in advanced analytics. We discuss these options further below.

Exhibit 3: Augmented Investigations

"Advanced analytic techniques include those such as data/text mining, machine learning, pattern matching, forecasting, visualisation, semantic analysis, sentiment analysis, network and cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, neural networks. Advanced analytics can be used to discover deeper insights, make predictions, or generate valuable recommendations."

Case Study 1 – Using Technology Assisted Review in a Regulatory Investigation

"~~Documents~~ Data wins – and defends – cases"

Scenario. Multiple regulators were investigating a company for alleged financial misstatements and failures. As a result, following the regulators serving notices to produce, the company had to turn over information which included all communication and financial data from senior executives, managers, and finance employees spanning a ten-year period. The collection of this data in a forensically sound and defensible manner, so that it could withstand the rigours of regulatory scrutiny, posed a significant challenge. This is because the matter involved significant complexity, that is, varying data sources across different jurisdictions, servers, cloud, older proprietary systems, encryption, and accounting data. Furthermore, the matter involved significant volumes of information; the forensic collection yielded tens of millions of documents.

Traditional approach. The parties agreed to a traditional approach of using search terms to identify and cull large numbers of documents for irrelevance. However, following this process, there was still millions of potentially relevant documents. In addition, the company was entitled to exclude certain privileged information from production, but this information had to be identified and removed.

The company needed to:

(i) identify relevant information;

(ii) identify and exclude privileged information; and

(iii) critically, undertake its own internal investigation by identifying key issues and 'hot' documents to remain appropriately informed of the regulators' investigations.

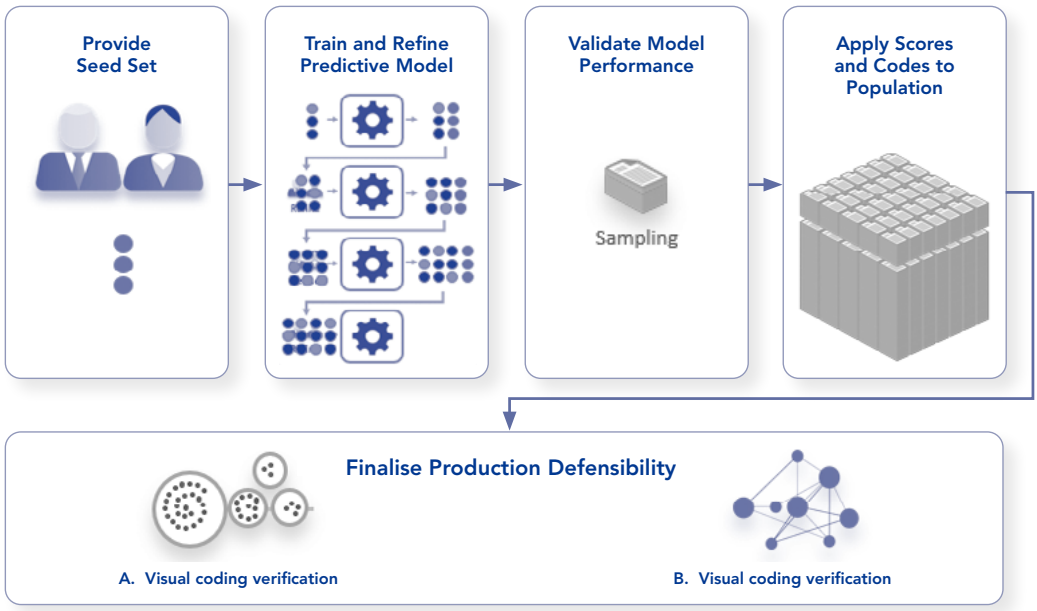
Technology-Assisted Review. Sifting through the remaining documents in a manual review, document by document, would take approximately six to eight years for a team of 30 investigators. The cost would also have been in the millions.

Therefore, the company engaged a digital forensics and eDiscovery specialist. They employed Technology-Assisted Review ("TAR") techniques. Rather than manually review the remaining millions of documents, TAR allowed the digital forensics investigations team to create a computer assisted model which ultimately would advance a much smaller subset of data for review. To create and train this model, the team employed the following steps:

1. A small set of documents was randomly chosen (sample set) to be reviewed by the investigations team.
2. Decisions were made based on the sample set of data, i.e. which documents were privileged and not privileged, which documents were relevant and not relevant, and which documents needed escalation and flagged as 'hot'.
3. The results were then applied to the rest of the population.
4. The results were analysed and quality-controlled (QC'd) by comparing the model's decisions with the investigations team's decision.
5. Another subset of data was reviewed and then again applied to the population.
6. Thereafter, the results were analysed again and QC'd.
7. This process was repeated five times to improve the accuracy and precision of the model, all the while analysing and quality-controlling the results at each round.
8. Once the accuracy and precision of the model was at a very high level, a validation was performed. Validation occurs based on visual analytics such as Categorisation and Relational/Network Analytics, as shown in the diagram below.
9. At this stage, the original full set comprising millions of documents was split between relevant and irrelevant, privileged and not privileged, and 'hot' documents were flagged.

The solution. When the TAR exercise concluded, approximately only 10,000 documents were identified as requiring manual review. This led to accurately and rapidly identifying relevant documents, a much easier process to identify and exclude privileged documents. The company was therefore able to satisfy regulator notices within specified timeframes. This was able to be completed within weeks rather than years. Critically, the TAR process allowed the company to identify particular issues (via the identification of "hot" documents), thereby giving the company important information and a strategic and timing advantage.

Exhibit 4: Technology-Assisted Review Approach



Regulatory investigation – Notices to produce
Approach, tools, and techniques: *map out critical data sources and custodians. Forensically collect data from all potentially relevant data sources based on the notices served. Index the data and isolate the most potentially relevant data. Apply TAR by sampling smaller subsets of the remaining data. Analyse and QC results. Repeat until results are accurate. Validate. Produce data to regulators. Gain critical information to the investigation.*

The "new normal" of digital forensics investigations: COVID-19's impact on conducting investigations

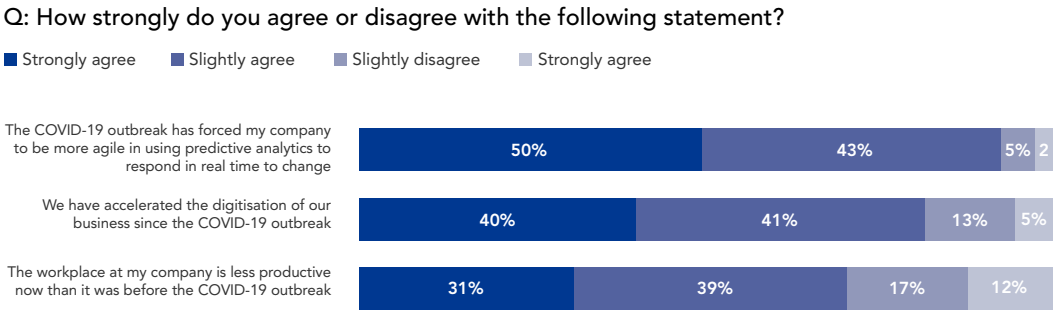
Given the acceleration of remote working due to the global pandemic, we have all witnessed the clear advantages to organisations. However, working remotely also introduced some challenges. They include:

- **The lack of supervision of employees and potentially undetected protocol breaches.** In the ever-present battle between accessibility and security, "under the cover of night", there has been an increase in insider threats, misconduct, fraud, and theft of intellectual property by employees, in particular given the increased pressure to sell. According to FTI Consulting's Resilience Barometer COVID-19 report, 75 per cent of the organisations surveyed were impacted by a cyber-attack in 2020 and 60 per cent of companies experienced heightened level of threat from insiders[6].
- **Co-mingling of company and personal data**, with the prevalence of BYO devices e.g. own mobile phone (and some organisations not having control or access).

[6] *https://ftiresiliencebarometer.com/wp-content/uploads/2021/02/FTI_RB_Report_Covid_Edition-_Final.pdf*

- **Data security**, working from home, in general, is not as secured as working from the office's secured network. Related to this, there is a growing trend, particularly in the financial institutions, insurers, life sciences, pharmaceutical, health industries, and education, in data breaches in the remote-working era. According to the report, "Phishing by Industry", firms in the construction industry have the highest percentage of 'phish-prone' employees in both the small and medium-sized business categories, ranking at 38 per cent and 37 per cent respectively[7]. While in the manufacturing industry, the number of publicly reported ransomware attacks more than tripled compared to 2019[8].
- **Inadequate technologies,** including premature release of technologies, when perhaps they should have been held back if not for the COVID-19 situation. During investigations, whilst undertaking interviews, FTI Consulting has witnessed, whether malicious or not, interviewees' internet connections dropping out mid-interview.
- **Data retention**, for example, employees opting for instant messaging versus official email communication. Some organisations, and in some jurisdictions, data retention has been challenged in remote-working due in major part to inadequate technology.
- **Data collection:** As digital forensics practitioners, we have been unable to travel when we would have otherwise done so to forensically collect data. In addition to the large volumes of data now having to be transferred via the internet (versus, pre-COVID-19, it was a direct "connection" with original digital media, which introduces speed and reliable connection issues), the challenges faced are identifying trusted partners, e.g. whether they be on-the-ground IT and finance personnel or vetted third parties. Furthermore, the added complications and requirements to give instructions remotely to IT, to provide encrypted hard-drives, and document processes, such as chain of custody forms.

Exhibit 5: COVID-19 has accelerated data trends



© FTI Consulting Resilience Barometer COVID-19 report

[7] *https://www.scmagazine.com/wp-content/uploads/2019/06/2019-Phishing-By-Industry-Benchmarking-Report-1.pdf*

[8] *https://hub.dragos.com/hubfs/Whitepaper-Downloads/Dragos_Manufacturing%20Threat%20Perspective_1120.pdf*

Insights

- According to FTI Consulting's Resilience Barometer COVID-19 report, there is significant investment from G20 companies in predictive analytics, with 93 per cent of respondents indicating their businesses have used technology to respond in real time to changes since the start of the pandemic.
- Over 80 per cent say they have continued to invest in digital solutions despite financial pressures.
- Since the start of the COVID-19 pandemic, 71 per cent of G20 companies have had, or are currently having, an investigation on financial practices.
- COVID-19 prompted 80 per cent of companies surveyed to accelerate the digitalisation of their businesses. In parallel, we are seeing a broadening of the cybersecurity threat landscape. 75 per cent of the organisations surveyed were impacted by a cyber-attack in 2020.
- As pressure mounts from stakeholders far and wide, 65 per cent of G20 companies have struggled to deal with the volume of regulatory alerts since the COVID-19 outbreak. 79 per cent are using AI and analytics to monitor scenarios that might impact risk and compliance, and these technologies are also being leveraged by investigators.
- 60 per cent of companies are experiencing a heightened level of threat from insiders. Sometimes this is a calculated attack, possibly from a disillusioned employee, but more often it is because someone inside the organisation has been taken advantage of.
- Three quarters of companies have seen cybersecurity climb up Board agendas as a result of COVID-19.

Case Study 2 – Remote Collection of Critical Communication for Transaction Context

Scenario. In 2020, a company was subject to an accounting malpractice investigation. The company was required to forensically secure data that could contain contextual evidence to support transaction anomalies from various electronic data sources. The company had adapted to remote working in response to the COVID-19 global pandemic, and subsequently made remote working a permanent part of its working arrangements within an ongoing broader digital and workplace environment transformation project.

Transaction Data. The transaction data resided on an accounting platform that enabled efficient and effective export of transaction data. The company's technology partner exported a copy of the transactions data to prevent modification, and made the data remotely available to the investigations team in a format suitable for detailed transaction analysis. Investigators searched for patterns, timelines, and abnormalities that were key flags for deeper transaction specific investigation. The data from the accounting platform had identified the transaction, so the search began for the context to each transaction to understand whether the transaction was actually problematic.

Onsite-Investigations. During a traditional onsite workplace investigation, an investigator could often gain an invaluable understanding of context and work culture. Onsite investigation actions would generally include formal investigation approaches such as conducting custodian interviews and assessing the practical logistics of executing multiple levels of transaction authorisation. Onsite investigations would also enable investigators to witness informal passing comments, use of paper documentation, and gauge the culture of security, authority, oversight, and discipline. When conducting remote investigations, this contextual information is not available. However, in this instance, remote working arrangements offered alternative sources of context.

Transaction Context. When the investigation related to an event that occurred during a time of remote working, then an increased amount of previously verbal discussion, comments, and approvals are usually documented electronically and retained on systems and devices that form part of the investigation. This contextual information may be recorded electronically, but outside of a financial or accounting platform. For example, transaction approvals and awareness, transaction discussions and negotiations, and even practices such as side-letters, or 'gentlemen's agreements' which can be prevalent working practices in specific geographic regions and industries.

Data Sources. The additional context to a transaction may be located in any electronic system that is used to transmit or store communications, decisions, workflow, or collaboration. This could include corporate email platforms and webmail accounts, corporate instant messaging, mobile device instant messaging, video calls including notes and agendas, and collaboration sites and tools.

Data Capture. Investigators knew that critical data (e.g., discussions about pending and current deals) resided on the mobile devices of key senior employees within group WhatsApp conversations, conducted via personal WhatsApp accounts. Due to the remote working environment, and the need to collect critical data with haste, a remote data capture of WhatsApp data was required. Investigators considered two options for remote collection. Both options required the knowledge and cooperation of the device custodians:

1. **iCloud Capture**. Ensure there was recent backup of the mobile device to the associated iCloud, then conduct a forensic capture of the iCloud account online including WhatsApp messages (using a forensic software solution).
2. **WhatsApp Capture**. Ensure all relevant WhatsApp conversations were known and available to the device user, then conduct a remote capture of specific WhatsApp conversations (using a forensic software solution).

Data Capture Considerations and Challenges. When considering the most appropriate data collection method there are a few important considerations. Firstly, defensibility, including the robustness, completeness, and forensic purity of the data collection process. Secondly, timeliness, including the potential loss or diminished value of data as a result of delay. Thirdly, proportionality, including the privacy impact of collecting or exposing deeply personal content from a data source or device which shares case critical data. In this matter, the cooperation of certain company staff meant the investigators had detailed and specific knowledge of relevant WhatsApp conversations (that is, group conversations between company employees) dictated that a full iCloud capture was disproportionate to the data capture objective as it would include considerable personal, non-corporate information. As such, investigators conducted a discreet, conversation-specific WhatsApp collection.

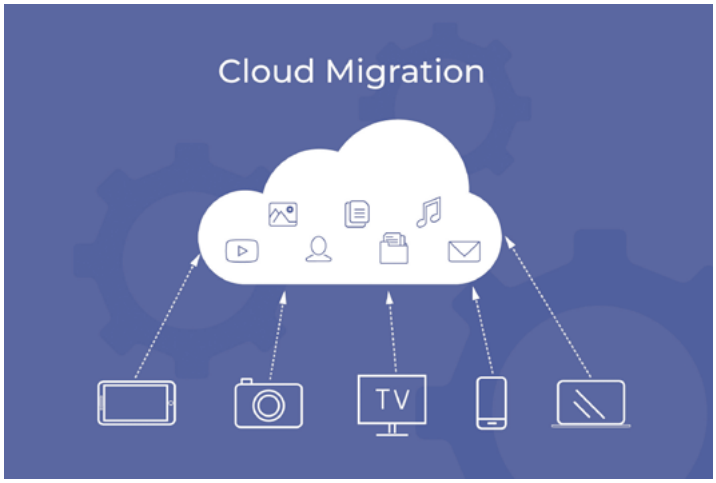
Lessons Learned. The company learned a few lessons that they took forward and incorporated into their working practices and information governance strategy. With regards to data security, they witnessed the ease in which critical corporate data can be exfiltrated using personal iCloud accounts and personally owned devices. With the new understanding that this is a common data egress point for IP theft by insider threats (i.e., bad actors who are employees), they took steps to mitigate this risk. The company learned the importance of only using approved corporate messaging platforms for business communications. Ensuring critical communications remain on corporate systems enabled them to apply appropriate data retention and disposal to be compliant with regulatory requirements, appropriate storage of data to secure and enable data utility, and compliance with relevant laws for the retention of books and records.

Case Study 3 – Collection of Historic Accounting Data following a Cloud Migration

Requirement. In 2020, during a procurement fraud investigation, a company needed to harvest accounting data from archived data held in a fuller server backup, following the migration of their accounting platforms into the Cloud as part of a "cloud first" IT strategy linked to a broader digital transformation project.

Accounts Cloud Migrations. When migrating accounting data into the Cloud, it is often the case that only essential current data will be migrated. This means that historic transaction level data for prior accounting years will be left in the old, traditional, on-premises solution, and ultimately lost when the system is decommissioned.

Exhibit 6: Cloud Migration



Archiving Historic Accounts. In this matter, the outgoing on-premises accounting software solution was simply switched-off, and a copy of the full accounting server was copied into archive storage. The accounting data itself was therefore left intertwined within the full server backup in archive. Notably, this was an option knowingly selected by the company. A common option is extracting all accounting data into readily accessible formats such as comma separated values (CSV) and retaining only the extracted data for potential future reference, or generating 'point-in-time' financial year-end backups that go into archive.

Restoring Accounts Platforms. When a system has been switched-off and placed into archive, it essentially becomes a cold, dark, and flat chunk of lifeless data which is not operable or readily accessible. To restore the platform (or bring it 'back to life'), there are various considerations and challenges. At the time of restore, the server system which hosted the platform may be outdated, unlicensed, unsecured, and in need of support and maintenance to bring it back to a fully operable state. The accounting platform itself can be equally as outdated and can have additional licencing challenges. Software licencing is often date-limited, and access to account may therefore be prevented. The username and passwords are often unique to the account platform, and therefore may be unknown or unavailable at the time of an attempted restore (due to staff forgetting the password, or staff moving on to new roles and being unavailable to investigators). In this matter, investigators were able to enlist the assistance of the accounting software developer to enable access to the protected and outdated platform.

Restoring Raw Accounts Data. In instances where it is not possible to restore the full accounting platform, it may be necessary for investigators to restore the raw accounting backup data into a format suitable for forensic interrogation. This method can be time consuming and costly, but when it is successful, it results in a very clean and flexible investigation interface which is unrestricted by historic platform capabilities and reporting functions, and which resides outside of the original platform that could modify or update data based on prior accounting routines and workflows.

Lessons Learned. The company in this matter learned that the purpose of an archive is to ensure the data is managed effectively against legally defined retention policies, and that it remains in a state that is accessible should it be required in the future. In this matter, leaving the accounting data intertwined with the accounts platform caused a delay to the restoration process and made the application of annual data disposal policy impossible to implement within their existing archive systems.

Collection, restoration, and analysis of historic accounting data following a cloud migration
Approach, tools, and techniques: *liaise with appropriate IT and finance personnel to identify data source(s) of archived accounting data and what software was used. Restore archived accounting data in a forensically-sound manner. If required, re-format, cleanse, and/or consolidate into a forensic analysis tool. Determine and apply advanced analytics tools, where necessary.*

Identifying opportunities & advice for organisations

Riding on the wave of digitalisation, despite COVID-19's impact on business operations, organisations are investing in predictive analytics. There are, however, some challenges. The challenges that investigators face at the intersection of digital forensics and accounting highlight certain data opportunities for organisations handling increasing amounts of data.

Organisations should focus on:

1. **Data Volumes:**
    a. Prioritising data that is relevant to the investigation, but also consider the potential for scope creep and the expansion of the initial investigation.
    b. Leverage the volume of data to predict any potential issues proactively, e.g. when a fraud, a data breach, or a flight risk/employee misconduct may occur.
    c. More generally, organisations should consider investing in uplifting their data governance. That is, organisations need to better understand what information they have, what they need to retain, and what information they no longer require, thereby defensibly and securely dispose of non-essential data. This allows organisations to better secure high-value and high-risk data, locate data when needed, limit the risk of mishandling data, ensure defensible, document compliance, and reduce costs by minimising data retention.
2. **Disparate Data Sources:** It is important to be able to bridge, connect, or consolidate disparate data sources to gain a centralised view of the data, and leverage this to provide value to the investigation. Organisations should consider using data science methods to ensure appropriate data sources are selected during a digital forensics investigation.
3. **Available and Accurate Data:** Engage relevant experts and internal resources when planning data collection, and ensure available data is complete, accurate and defensible. Organisations should also leverage data by employing fraud, data breach, and misconduct detection, e.g. anomalous data such as increased data traffic and irregular access into organisation's systems such as Customer Relationship Management Systems, Document Management Systems, other applications, and accounting systems.
4. **Data Protection and Privacy Regulations:** Be proactive in understanding and limiting privacy risks; implement privacy-by-design, and use privacy impact assessments to proactively identify privacy risks and mitigate them. Techniques such as the use of synthetic data in testing, secure sandboxes, and rigorous supplier governance should be employed. When conducting investigations, organisations should be aware of and ensure compliance with data protection and privacy regulations. Privacy obligations vary from jurisdiction to jurisdiction, and there may be different notification and handling requirements when collecting data from custodians in different jurisdictions[9].

Augmented investigations are not a call to discard traditional approaches or abandon foundational principles of robust investigations. Rather, new tools and discovery methods complement existing forensically-sound approaches and deliver intelligible visualisation with comprehensive information to digital forensics investigators for further interrogation and analysis. It is therefore important for investigators, and accounting professionals, to have broad familiarity with the options available and more importantly, to have enthusiasm to explore the technologies that may be helpful when conducting and managing an investigation.

[9] *http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.149.5392&rep=rep1&type=pdf*

CASE STUDY

CREATING A DIGITAL STRATEGY WITH THE HUMAN TOUCH

CHAPTER 10

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Introduction

The 'digital and mobile-first' era that marks the 2020s has revolutionised the banking and payments space, leading to an array of digitalised innovations that are helping to reconfigure life for the modern consumer.

Picture this: You pick up your phone and speak into it, triggering a banking transaction with just your voice. As you go about your day, buying a cup of coffee, picking up some groceries and consulting a doctor over a nagging sprain, you pay for everything through your mobile banking app. For every payment made, you are amassing reward points which can be redeemed across a wide range of areas in retail, F&B and hospitality.

As you sip your latte, you get a ping on the app reminding you that you are dangerously close to exceeding your budget for the month and that you have spent $200 on coffee alone during this period (you always knew you bought barista coffee regularly, but not how much it actually cost you every month). The notification also alerts you to how – had you saved your coffee money and invested it instead – the returns after a year may have helped fund a month of steady coffee drinking.

Other pings suggest investment ideas for you to consider based on your areas of interest as well as investment insights from our wealth advisors. The markets are turning volatile, so another notification pops up – alerting you that an investment you made months ago may now no longer be optimal for your investment portfolio. You quickly video call your wealth advisor, who taps on AI-driven insights to offer personalised suggestions that would beat most of the major indices in terms of returns. Using a text message, you provide the necessary approvals for changes to your investment that the advisor can proceed with. And when you're about to head off for dinner, yet another pop up suggests some restaurants near you where your credit card will get you a bigger bang for your buck.

This is how your life could well be like in a few years, and this is how banks may serve you as it evolves. Some of what was just described is not only possible but already happening. Artificial intelligence will grow its power to improve our daily lives as it learns our preferences and behavioural patterns and uses these to anticipate and meet our needs. You will no longer have to actively manage investments for your retirement or tend to administrative banking tasks like paying your insurance bills or tracking your expenditure. Digitalisation offers the chance for banks to offer personalised solutions, including wealth management tailor-made to fit your needs.

The power of commitment

Over the past 10 years, the OCBC Consumer Banking division, which serves individuals from the mass market to high net-worth individuals in Singapore and the region under the OCBC Premier Banking brand, has invested heavily in digitalising the way we serve, the way we work and the way we operate. Our significant investments have been to digitalise both our customer-fronting platforms such as our mobile banking app and website, as well as our internal processes and operations.

With technology, we have been able to make use of robotics and artificial intelligence to automate the mundane every-day tasks so that our staff can spend their day performing higher-value work. As an example, we have enabled all our Singapore financial advisers since November 2020 with digital tablets with access to the entire bank's customer relationship management (CRM) system. This allows them to meet customers anywhere, anytime to conduct customers' financial needs analysis and make investment decisions. All done online.

Our bank's overall technology spending in recent years has grown steadily both in absolute value and as a proportion of our total expenditure. We have a clear vision of what we want to do. We are backed by the firm support and commitment from our senior management. This sustained and sustainable investment into technology is not a one-off thing as we constantly have to change and adapt to the rapidly-changing technological landscape. Our technology budget is not based on an annual plan, and not subjected to the quarterly financial reporting pressure. Rather, we take a long-term strategic view.

We have been ramping things up, aggressively deploying the Agile methodology as we roll out new digital features every 30 days.

This is a big commitment. Without such a commitment, it would be very challenging for any organisation to continuously launch digital 'firsts' in the market. Such innovations are critical to engaging customers continuously and showing them how we can add value. Only thus convinced will customers be nudged to go digital.

Being the second largest bank by assets in Singapore, as well as in Southeast Asia, can make us complacent. It also makes us more complex. OCBC's broad geographical footprint in North Asia and Southeast Asia, and our regional presence with a long, rich history of serving a broad segment of individuals and businesses well can also make us 'comfortable'. Many big organisations fall into this 'trap' of complacency and lethargy. We make sure we do not.

OCBC has led the industry in rolling out numerous digital firsts in areas such as instant account opening and loan approvals, contactless payments and biometrics. These include everything from AI-enabled facial recognition at branches in 2017, to being the first to enable instant digital account opening in 2018, to enabling customers to withdraw cash at OCBC Bank ATMs using QR codes in 2019, to enabling digital approvals for home loans in an hour and car loans within 60 seconds in 2020, to enabling face verification for ATM banking transactions in 2021. We aim to digitalise all aspects of banking to make it simple, seamless and of value to our customers.

Of course, the COVID-19 outbreak in 2020 has played a role in significantly increasing consumer digital adoption.

In 2020, the number of OCBC Bank 'digital debutants' – customers who were active digital users in a given year but not in the previous year – reached 200,000. At the end of 2020, 56 per cent of our customer base were active users of digital banking compared to 39 per cent in 2015.

While the drive to innovate has become a necessity in a hyper-digital landscape, a powerful digital strategy has to go beyond technological innovation. It has to be grounded in one cornerstone: The customer.

It's All About the Customer, Customer, Customer

There is an old saying that goes: 'You need to be where your customers are'. This saying is truer in the digital world.

New digital technologies have greatly heightened customer expectations. Customers these days want it fast. They want it easy to use and they want it free. So, how do we achieve customer satisfaction? And still be profitable?

We always begin with our customers in mind, asking ourselves how we can better understand their pain points and their requirements so that we can better serve them. We do not take a one-size-fits-all approach. It is absolutely crucial to understand the different needs of different customer segments and provide solutions that fit each segment.

While English is the predominant language in Singapore, we ensured that our app has multiple language capabilities. We were the first bank to offer Chinese on our app. For the younger customer segment that is more environmentally conscious, we did away with every piece of paper in every banking transaction. We are moving to that for all customer segments but some of our older customers still ask for paper receipts and some are more comfortable with paper forms and verification.

In everything we do, we strive to make all aspects of banking simple, seamless and, most importantly, of value to our customers.

Anchoring on the 'Three Ds'

There are three key drivers propelling our digital strategy. These are what we call the 'Three Ds' – digital, data and design.

1. **Digital** – This is deeply rooted in our business fundamentals and embedded across our platforms and products. Digitalisation runs through our entire bank, changing the way we work as well as the products and services we offer to our customers.

2. **Data** – We are putting Big Data to work in big ways, from cultivating customer loyalty through innovative and personalised offerings to being ceaselessly vigilant when it comes to cybersecurity.

   Data feeds us the intelligence to better understand and serve our customers, making sure what we offer the customer has value and is relevant to them. With data, we can be better (in products and services), faster (in delivery) and stronger (in being cybersecured).

3. **Design** – Contrary to popular belief, banking can be and should dare to be beautiful. The ease of use, user-intuitiveness and overall experience matters. Beauty must go hand-in-hand with a great customer experience and a great customer journey. That is why design has to be in our DNA.

When we do this well, there is a huge opportunity for us to improve the simplicity of our services, increase our transparency and hence increase trust between the customer and the institution.

Identify Digital Value Propositions

- **Instant Origination** – open an account, take up loans or apply for a card almost instantly
- **Self-Driving Finance** – be entirely in charge of your own daily money management
- **Digital Wealth** – manage your wealth and investments on the go
- **Lifestyle & Payments** – rewards, deals and seamless digital payments

Instant Origination

Because of the high digital adoption rate in Singapore, consumers want everything fast. So speed is a key criterion in digital innovation: How do we get the answer to consumers in the fastest possible way; how do we reduce the number of clicks needed to complete a transaction; how do we minimise the wait time.

Customers used to gripe about how it took hours, days, and sometimes even weeks to open a bank account, get a loan approved or get a credit card.

Now, we give customers tools to help them determine – before they even apply for a loan – their affordability to buy that favourite-brand car or the dream home. We totally revamped our proprietary Know-Your-Customer (KYC) and credit assessment systems, made them digital and real time, and integrated them fully with the Singapore national data repository MyInfo. Today, it takes just 60 seconds for our customers to get a car loan approved; a few minutes to open a bank account; and 60 minutes to apply for and get a home loan approved.

Self-Driving Finance

A lot of people look at their bank statements at the end of the month and ask themselves – Where did all my money go? They do not realise that their daily artisanal coffee formed such a large part of their expenses; nor that their daily cab rides to work was taking a sizeable chunk out of what they could be saving.

Self-driving finance is all about control. The ability to have good control over your money comes with relevant and insightful information and data. We use the information and data to make customers more aware of where their money is coming from and where their money has gone to. By having the knowledge pushed to you continuously and on a timely basis, you will develop better money discipline and be able to better manage your expenses. With visibility and clarity of their money flow, we seek to help customers see savings in their bank accounts at the end of the month.

By leveraging data from customers' accounts and transactions, we offer a highly-personalised experience through contextual 'nudges' – or insights – via our digital banking platforms, providing them with information on how they can manage their money better through, saving, budgeting, or getting better value out of their credit card spending.

Another strong feature to promote self-driving finance is the benefit of knowing 'People Like You'. By allowing customers to compare their spending and saving habits against their peers, customers are motivated to better their peers or even scare them into actions if their peers are more effective savers and money managers.

Digital wealth

The ubiquitous mobile device has become a tool of 'democratisation', enabling us to reach more customers and segments – from the savvy investor to the uninitiated – to provide them with access to quality wealth advisory and products. We plan, design and build our mobile banking app with a vision of creating a comprehensive wealth management digital tool.

Our customers are able – anytime, anywhere and even on the go – to plan effortlessly for their retirement or children's education and invest to grow their wealth and to track their portfolios. Our straight-through processes allow customers to receive insights and advice and directly make investment decisions all on the same platform.

The launch of open banking by the Singapore government in December 2020 should, amongst other advantages, deepen consumers' ability to manage their finances. With full visibility of their entire portfolio, a customer is better able to see if they are making or losing money which ultimately helps them know if they are making progress towards their financial goals.

But simply tapping the Singapore Financial Data Exchange (SGFinDex) – so that a customer's banking and personal financial data can be pulled from accounts with multiple banks and government agencies, then displayed in one place – is not good enough. The user experience as well as the suite of offerings that exploits this 'pulling' must be superior and meet customer needs. Failing that, the data is not useful but remains an 'FYI'. Agile squads were formed to ensure that customers were clearly guided in leveraging open banking to make more well-informed choices and act to secure or improve their finances. As a result, more OCBC customers 'pulled' their data with other banks to be displayed with their OCBC accounts than the other way round.

With the rich data and insights gleaned from supporting the online financial planning, investing behaviour and risk appetites of customers, we then curate and offer wealth products that customers can invest in to pursue their financial goals. Customers can choose whether to give instructions to their relationship manager through digital channels or to self-serve on our digital platform – buying, selling and monitoring unit trusts with real-time dashboards, investing in AI-created portfolios of exchange-traded funds and stocks and investing in a disciplined, affordable way in blue-chip stocks. All done digitally, on your mobile phone. This is what we call Digital Wealth.

Lifestyle and payments

Consumers used to panic if they left home without their wallets. Today, the bigger worry is that they did not bring their mobile phones with them.

With just their mobile phone and through the OCBC's payment app – OCBC Pay Anyone – customers can go through their day without feeling like they are caught in a bind. With their mobile phones, they can pay for that brunch and coffee at the latest hipster café; withdraw cash at the automatic teller machines through the simple scan of a QR Code; and even split the bill for the dinner they had with their friends.

What I have described above is only possible with an open-loop e-payments system. An open-loop e-payments system is another critical component of our digital strategy. We do not believe in closed-loop systems because it simply does not provide convenience to consumers. If Singapore is to truly become a smart nation, open nationwide infrastructures that have universal acceptance across Singapore, enabling multiple bank users to ride together, are crucial. Our OCBC Pay Anyone app has thus been built on an open platform that can be connected universally to banking systems to enable a common payments platform. The app is embedded in numerous third-party lifestyle applications to provide customers a seamless payment experience for their digital purchases which are truly ubiquitous and extremely easy to use.

To deepen customers' relationships and interactions with us, so as to build brand loyalty and engagement, we have to think beyond banking. We are not building a super app which is all pervasive, but an app which serves customers where it truly matters and where there's a connection with banking. We are building an ecosystem around three key areas of customers' lifestyles and payments – health and wealth; travel; and e-commerce – so that whether someone needs to see a doctor, buy a gift for a loved one or – when travel restrictions are relaxed – plan for a well-deserved holiday, everything is paid easily from their bank accounts or with their OCBC cards online on OCBC platforms. And as a consumer pays for their various purchases throughout the day, reward points from all merchants are accumulated and not wasted. These reward points are used to exchange for cash vouchers or discounts across a wide range of services such as F&B, healthcare and hospitality. In fact, we have already created this rewards platform, called STACK. It is only a beginning. These eco-systems play a critical role in our digital strategy.

Technology alone is not the key differentiating factor

Customers' financial needs are wide-ranging. Some are becoming more complex. Customers do not want to interact with banks just via digital-only channels. It is about availing the desired channel to the customer, whether digital or in person or by phone, as and when the customer wants it, with any transition being seamless.

To meet these changing customer expectations, our employees must also adapt. The talent we bring in must have a digital-first attitude, an agile mentality and a growth mindset. Beyond that, however, we must never loosen our embrace of a customer service mentality. At the end of the day, we are in the service industry. Despite huge leaps forward in digitalisation, the best customer experiences in banking cannot be delivered solely through digital channels.

Beyond the nuts and bolts of technology, there are two key areas we focus on developing:

1. The next generation of branches
2. A digitally-transformed culture

1. Building the next generation of branches

Banking must never lose the human touch. This is because banking is not just about transactions, but about building relationships and trust that last. It is true that most of the usual branch banking transactions can now be performed on our Smart ATMs or a mobile banking app; nonetheless, customers still want the option of walking into a space for that face-to-face experience with bankers when it comes to more complex and deeper financial advisory conversations, especially in wealth management and home ownership.

Accordingly, physical branches will still have a clear function in a digital world and they are being restructured so they are less a centre of traditional branch banking roles than they are strategic assets in a world of digital banking. Put another way, even as we arm our digital marketplace with financial tools that allow for 'clicks', we are simultaneously designing 'next-generation' branches that are true to our 'digital, data and design' ethos. We envisage branches to be, first, fully integrated with digital platforms to provide a seamless customer experience as customers move from our mobile app to our branch to holistically meet all their banking needs.

They will be spaces where customers go to have that deeper conversation with wealth advisors about their portfolios.

Also, since 2018, we have transformed many bank teller roles into those of digital ambassadors at the branches. These branches will therefore also be where our customers are introduced to new digital offerings.

Importantly, our 'next generation' branches will continue to be located where our customers live and work. Financial planning and retirement planning are not top of minds of Singaporeans. Our OCBC 2020 Financial Wellness Index found that 3 in 4 Singaporeans are not on track to meet their retirement plans. That is why we want to ensure that it is convenient to be able to walk into a branch after a Sunday brunch, grocery shopping or during lunch hour, sit down with a trusted wealth advisor in a comfortable setting, and plan for one's life goals.

2. Creating a digitally-transformed culture

Employees have to let go of old habits and learn new behaviours. As I tell my colleagues, we have to always learn, un-learn and re-learn. As an organisation, we are committed that we will not leave anyone behind. We will equip everyone with the relevant tools and technical knowledge to understand user experience, customer journey, data and APIs. We are committed to giving every employee all the training needed to continue to stay relevant.

A digitally-transformed culture is one that encourages employees to look outside of their own functions and engage with customers and partners to develop new solutions that bring real value. Employees must be willing and able to work in a dynamic, nimble and iterative process. Bosses must allow employees to fail, learn from mistakes and improve. In a digital world, it is all about the speed to market. We let employees launch, test and learn, in multiple iterations. If we fail, it is ok to pull back, fix the problem and roll-out the improved versions. Such flexibility to adapt and move very quickly must be in the DNA.

For every new product and every new feature we work on, we form agile squads comprising 10 to 15 people not just from different parts of the consumer banking business but from across the whole bank. These squads think like a start-up and work like a start-up. The passion to create something unique that is of value to customers is shared by every member of every squad. The collaborative spirit is strong. At any one time, there are at least 20 squads. Feeding off data, constant customer feedback, we fine-tune products so that new products or new features are introduced every 30 days.

While transforming the way we work is important, employees must be appropriately trained, re-skilled and up-skilled. Data and design are relatively new disciplines so many employees need to be brought up to speed by attending relevant training. Upon joining us, all new management trainees go through courses in data literacy; we also put current employees through a structured development programme which will see them eventually certified as data scientists or data analysts. Our product teams are put through human-centred design masterclasses, taught by in our in-house group of design gurus, so that design elements become second nature to them when conceptualising products and features.

With fewer customers needing to perform traditional branch banking transactions, our branch staff are being up-skilled to take on the higher-value roles mentioned earlier, such as wealth advisory and financial planning. While it takes time to transform, it is only fair to give every employee the opportunity to be part of a digitally-transformed culture.

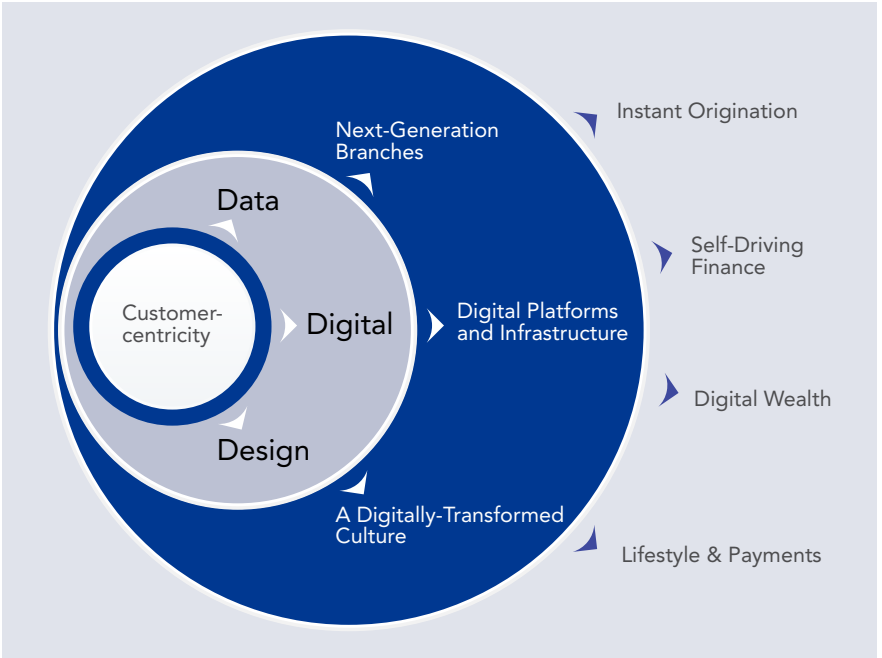

Figure 1: OCBC Bank Consumer Financial Services Digital Strategic Framework

Conclusion

Many see digital strategy as a technology strategy. This is a mistake. A successful digital strategy is one that integrates technology with data, design and other customer touchpoints. Everything we produce is done through the lens of simplicity and with a human touch. Only then will a digital strategy translate to a simple, seamless and holistic delivery that delights customers.

PREPARING ACCOUNTANTS OF THE FUTURE: A PROGRAMME IN ACCOUNTING DATA AND ANALYTICS

CHAPTER 11

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Disruption of the accounting profession

The accounting profession is rapidly evolving due to technological innovations. Technologies such as the Internet of things, smart sensors, cloud computing, robotics, and artificial intelligence are combining to disrupt the way that businesses operate. It is predicted that, over the next decade, information technology (IT) will significantly transform the accounting profession.

IT is expected to enhance transparency, accuracy, and the communication of financial information as well as offer opportunities for accountants to create value, perform more in-depth analyses, and provide timely financial advice. Some of the IT-enabled transformations in accounting will involve automation of not only mundane bookkeeping tasks but also complex, multifaceted processes including financial closing processes and fraud and forensic accounting. The accounting profession expects the adoption of smart software and analytics that will enable better and near real-time reporting, allowing accountants to transition from retrospective to predictive analysis, and highlighting the interconnectedness of financial and non-financial performance.

In 2020, CPA Australia commissioned a research study to examine the impact of technology on the desired skills of early career accountants[1]. The study highlighted concerns in the accounting profession that graduate talent does not have the right mix of skills and is not adapting to evolving skill requirements. The study identified technological literacy as the most highly desired skill set for accountants joining the profession and highlighted that the perceived impact of technology on success in the accounting profession was greater among early career accountants than managers. Similarly, the Singapore National Skills Framework for the Accountancy sector[2], which guides individuals to acquire future-ready competencies as the accounting profession continues to transform in the digital age, has identified data analytics as one of the top emerging skills required in the accounting profession.

It is clear that practitioners and academics in the accounting profession need to rethink about the future of the profession and to take active steps towards embracing digital transformation.

Incorporating technologies in accounting education

Although technological advances are set to transform the accounting profession in the coming years, there is a significant shortage of accounting professionals who possess the relevant skillsets to exploit these advances. To effectively leverage technology, accountants will need to develop new paradigms and skills. Within this regard, there have been calls for university programmes capable to equip accounting students with technology skills that they will bring to the future workplace.

Many employers have also shared their view that to better prepare students for the opportunities and challenges ahead, universities should infuse analytical exercises into existing curricula in order to help students develop proficiency in data and analytics, in addition to core accounting skills. Currently, firms are often forced to assemble two separate groups – one with expertise in accounting and the other with expertise in technology – to work together on complex issues requiring skillsets from both groups.

[1] *https://content.cpaaustralia.com.au/podcast/5-ways-technology-changing-accounting-skills*

[2] *https://www.sac.gov.sg/skills-framework*

The Association to Advance Collegiate Schools of Business, also known as AACSB International, is a leading international accreditation body for university accounting and business programmes. It connects educators, students, and business to groom the next generation of great leaders. AACSB recommends that accounting degree programmes should include learning experiences that develop skills and knowledge related to the integration of IT in accounting and business. These experiences include development of skills and knowledge related to data creation, data sharing, data analytics, data mining, data reporting, and storage within and across organisations. This is articulated in AACSB's International Accounting Accreditation Standard A7 (Information Technology Skills and Knowledge for Accounting Graduates)[3].

Further, the International Federation of Accountants also highlights that relevant skillsets, including those in IT, statistics, and data modelling, should be integrated in university programmes for both current and future accountants.

In Singapore, there has also been extensive discussion on the role of IT in accounting. For example, in 2015, the Singapore government established a committee on the future economy to develop economic strategies that can position the country well for the future. As part of the committee, a working group on legal and accounting services was formed. In its 2017 report, the working group acknowledged the role that technology will play in the jobs of accountants and recommended that universities should embed technology into the accounting and law curriculum. According to the Skills Framework for Accountancy published in 2020, digitisation and data analytics are among the core skills which will grow in demand as the accountancy sector continues to transform.

Consistent with these views, the Pathways Commission on Accounting Higher Education of American Accounting Association, a premier community of accountants in academia, highlights in its recommendation the need for universities to develop curriculum models, engaging learning resources and mechanisms for easily sharing them. Further, the commission also notes that to achieve this, vital programmes, courses and approaches require systematic attention to curriculum, pedagogy, and opportunities for renewal. Specific objectives articulated to accomplish this recommendation include engaging the accounting community to define the body of knowledge considered to be the foundation for accounting's future curricula and implementing curricula models for the future.

Case study: SMU school of accountancy accounting data and analytics second major programme

(i) Background

In response to the call to prepare accounting graduates for digital transformation, SMU School of Accountancy (SOA) launched the Accounting Data and Analytics (ADA) Second Major programme in 2018 that students can pursue to complement their Bachelor of Accountancy degree programme[4].

[3] *https://www.aacsb.edu/accreditation/standards/accounting*

[4] *https://accountancy.smu.edu.sg/bachelor-accountancy/curriculum/2nd-major-accounting-data-and-analytics*

The ADA programme is the first of its kind in Singapore. It aims to equip students with the relevant skills in data and analytics, which are in demand in the accountancy sector. This is particularly important considering that the need for accountants to become more tech savvy and conversant with data has been identified as one of the important ways that can help the accounting profession continue to thrive amid digital transformation. Universities need to ensure that their accounting curricula meet these needs.

During the programme development phase, SOA conducted focus group discussions with 23 representatives of major employers of accounting graduates in Singapore to gain insights into the relevance of a programme in accounting data and analytics for the accounting profession. Specifically, 15 participants were from the Big Four accounting firms and held senior positions such as audit partner, director, and chief information officer while eight participants were from major financial institutions and held senior positions such as head of finance and general manager of financial management.

Participants were supportive of the ADA programme and provided valuable insights. They agreed that accountants of the future should be exposed to new and emerging technologies that are relevant to the work of accountants. Participants commented that the following would form the core data technology skillsets required of accountants of the future: (i) data management, (ii) data modelling and visualisation, and (iii) statistical tools/programming.

(ii) Curriculum Structure

Students need to complete eight courses to gain the ADA second major. The curriculum is designed based on three pillars: (1) data technology, (2) analytics electives, and (3) accounting analytics capstone. The structure of the ADA programme is illustrated in Figure 1.

Data Technology (Pillar 1) **(4 compulsory courses)**	**Electives (Pillar 2)** **(Any 3 courses, selected list)**
▪ Accounting Information Systems ▪ Business Data Management ▪ Data Modelling and Visualisation ▪ Statistical Programming	▪ Forecasting and Forensics Analytics ▪ Analytics for Value Investing ▪ Audit Analytics ▪ Auditing Information Systems ▪ Blockchain Applications in Financial Services ▪ Accounting Data and Analytics Work-Study Elective
Accounting Analytics Capstone (Pillar 3) **(Compulsory, Experiential learning)**	

Figure 1: Curriculum structure

Students will take four compulsory courses under the data technology pillar to equip themselves with basic data and analytics skill-sets useful for accountants. These courses include accounting information systems, business data management, data modelling and visualisation, and statistical programming.

In the second pillar, students will learn to apply these basic data and analytics skillsets by completing three electives courses. Electives available include forecasting & forensic analytics, analytics for value investing, audit analytics, auditing information systems, blockchain applications in financial services, and work-study elective.

Lastly, in the third pillar, students are required to apply the skills learned in the first two pillars by completing a compulsory accounting analytics capstone course. A key pedagogical innovation of the ADA second major is the compulsory accounting analytics capstone course that employs the unique award-winning SMU-X experiential learning pedagogy, which will be discussed below. Completing a capstone course helps students integrate and apply the knowledge, skills and abilities.

(iii) Learning Outcomes

The learning outcomes for the five compulsory courses are:

(a) Accounting Information Systems: Our students can use data flow diagrams and system flowchart to document business processes, analyse internal control weaknesses and recommend business process improvements.

(b) Data Management: Our students can apply data modelling techniques to design a database.

(c) Data Modelling and Visualisation: Our students can use appropriate modelling techniques to solve accounting and business problems.

(d) Statistical Programming: Our students can implement statistical analysis operations using a programming language to solve accounting and business problems.

(e) Accounting Analytics Capstone: Our students can apply data analytics skillsets to deliver solutions for real-world projects.

Please see appendix for course synopses.

(iv) Collaborations with Industry Partners

The compulsory accounting analytics capstone course is delivered via the SMU-X experiential learning pedagogy. The SMU-X experiential learning pedagogy was introduced in 2015 as a university-wide programme[5]. Students have the opportunities to work in groups to help companies solve real-world problems.

SMU-X is an experiential learning framework which calls for students to take on real-world challenges by collaborating on projects with corporates, non-profit and government organisations. The framework represents a paradigm shift in the traditional approach to teaching and learning; from being teacher-centred to active learning by students while working on the real-world problems. SMU-X also encourages instructors to collaborate closely with industry partners.

[5] *https://x.smu.edu.sg/*

The SMU-X experiential learning pedagogy is built on four principles (see Figure 2).

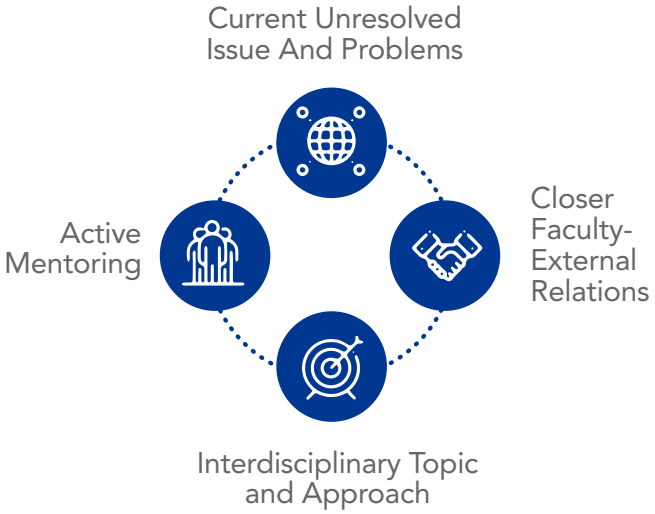

Figure 2: Four Principles of SMU-X Experiential Learning Pedagogy

The four principles are:

(a) Project-based experiential learning – combines academic with experiential learning through the heavy use of projects from industry partners;

(b) Interdisciplinary approach – challenges students to use their knowledge and skills to tackle real-world problems through interdisciplinary approaches and activities;

(c) Active mentoring – partners with corporate, non-profit and government-sector organisations. Industry partners and faculty are involved in active mentoring so that students benefit most out of this collaborative relationship;

(d) Tripartite learning loop – students get a better understanding of what it means to use theory learnt outside the classroom; faculty learn how real-world adapts theories; industry partners deepen their own learning through faculty and students' findings. This inculcates in our students, faculty and industry partners the value of continuous learning in a volatile, uncertain, complex and ambigious world.

Through the SMU-X principles, the accounting analytics capstone course provides students with opportunities for active and collaborative learning, interactive experiences, access to subject-matter experts from academia and industry, and a deepened understanding of diversity and interconnectedness. Below are three examples of industry projects completed by students during the compulsory accounting analytics capstone course.

(a) Singapore Exchange (SGX)[6]

SGX requested the students to devise a solution for their current revenue forecast process. The present system of SGX requires human intervention to manually sift through various new data sources to determine the inputs for their forecast. This method may lead to higher chances of inaccuracy as significant human judgement is used to determine these inputs. The student group proposed converting the semi-automated revenue prediction process to a fully automated one in order to streamline the process and eliminate the human judgement bottleneck. This would enable a standard operating procedure, reduce total man-hours and improve the process accuracy over time.

(b) Seng Hua Hng (SHH) Foodstuffs Pte Ltd[7]

SHH requested the students to develop in-house data analytics capability to help the company achieve its strategic goals. Previously, SHH would rely on estimates to make key strategic decisions such as to determine annual production capacity. The key challenge of utilising estimates was the lack of accurate demand forecasting on a periodic basis and the absence of important financial information that would support the risk assessment of expansion into new foreign markets. The student group leveraged on predictive analytics to find valuable insights such as expansion plans for both domestics and overseas, new product introduction possibility and better estimation of future financial targets.

(c) XDel Singapore[8]

XDel was confronted with payables-related challenges. Previously, their finance department used manual processes, which was very time consuming and prone to errors. Due to the manual processes, there were certain issues such as difficulties in reconciling payments, delayed payments to suppliers and non-payment to suppliers. The student group assisted their finance department to automate their processes. They also derived a formulae for the company to calculate the cost per driver which they could implement in their cost management tool for better costings. XDel implemented the students' solutions and experienced a reduction in late and non-payments.

Increasingly, higher education has been called upon to train students to be more agile and capable of dealing with complex issues and systems at work. Therefore, there is a need for an education where students are rooted in content knowledge and be provided with hands-on learning that mirrors real-world problems, coupled with interdisciplinary work opportunities.

(v) Work-Study Programme

Under the ADA second major programme, students can also opt for the Accounting Data and Analytics Work-Study programme (WSP)[9]. Under this WSP, students will have the opportunity to undergo a 20-week extended internship at EY in Singapore across its service lines in assurance, tax, strategy and transactions, and consulting.

[6] *https://blog.smu.edu.sg/academic/schools-libraries/smusoa/solving-real-world-issues-through-smu-x-accounting-analytics-capstone-project/*

[7] *https://accountancy.smu.edu.sg/student-project-showcase/project/undergraduate-project/building-house-data-analytics-capability*

[8] *https://x.smu.edu.sg/project-showcase/xdel-singapore*

[9] *https://news.smu.edu.sg/news/2021/05/19/smu-accounting-data-and-analytics-work-study-programme-industry-experience-ey*

SMU aims to put in place work-study options where students may undergo longer internship durations to better interlace institution-based learning with structured on-the-job training and to facilitate more impactful work opportunities within the attachment company. This is another collaboration with industry partners, besides the accounting analytics capstone course.

Before embarking on the extended internship, students are required to complete two courses (data modelling and visualisation, and business data management). During the extended internship, students will alternate between working four days at EY, and studying on campus for one day each week. In contrast, students typically complete a full-time 8~10 week internship during their holidays. Through the 20-week programme, students will work on a data analytics project. Students will learn about the forms of data, how to analyse data and draw insights from it. Importantly, they will also gain exposure to and better understand how a professional services organisation like EY leverages data-driven insights to deliver exceptional service to clients.

Conclusion

The ADA programme is expected to benefit students by equipping them with relevant skillsets required for accountants of the future. Even as the accounting industry seeks to incorporate technology into its processes, there remains an acute lack of accounting professionals who possess the necessary technology skills required. As such, students who complete both a Bachelor of Accountancy degree and the second major in accounting data and analytics would be well placed to fill the "skills gap" that has developed in the accounting industry, thus improving their career prospects upon entering the industry.

Given the lack of accounting professionals who possess the necessary technology skills in the marketplace, employers can benefit from the ADA programme training accountants with key skills in data and analytics. Given the potential for technology to improve productivity and spur growth in the accounting profession, the hiring of accountants who also possess critical data and analytics skills to drive the implementation of technology would give firms a key competitive advantage over their competitors. A focus on incorporating data and analytics in accounting education is timely.

Appendix: course synopses

Data Technology (Pillar 1)

1. Accounting Information Systems

This course adopts a business process approach to examine accounting information systems concepts and explores the critical characteristics of information that must be considered in systems design, implementation and application. This course will expose students to systematic documentation and analysis of key business processes, database modeling, and the role of internal control in an accounting system and processes.

2. Business Data Management

This course will cover fundamentals of relational database theory, important data management concepts such as data modeling, database design, implementation, data access, and practical data-related issues in current business information systems. Upon successful completion of this course, students will be able to understand the role of databases in integrating various business functions in an organisation, query a database using Structured Query Language and gain familiarity with some commercial database tools (MS VISIO, MySQL).

3. Data Modelling and Visualisation

This course will introduce a variety of quantitative techniques used in the development, implementation, and utilisation of analytical data models that accountants regularly use in decision making. It will cover techniques including regression analysis, trend analysis, optimisation, text analytics, and simulation. Visualisation provides an important means through which accountants can communicate insights obtained via data modelling to their intended recipients. This course will introduce students to key principles and techniques for data visualisation. Students will create visuals including dashboards and interactive visualisations for decision making in the accounting context.

4. Statistical Programming

Given the heavy use of statistics in analytics applications, this course aims to provide students with the foundation in statistical programming that is crucial to all four stages of analytics (descriptive, diagnostic, predictive and prescriptive). This course will focus on the use of R Programming to develop students' statistical knowledge. Students can then build on their foundation in R and apply it to analytics applications, specifically in the accounting context.

Selected Elective Courses (Pillar 2)

5. Forecasting and Forensic Analytics

This course explores how data can be used to solve accounting problems in across financial accounting, managerial accounting, audit contexts. Students will use gain exposure to techniques to explore how financial and non-financial data is used to forecast events, detect financial discrepancies and frauds, predict corporate default, optimize operations, and determine business strategy. Some advanced analytics methods such as text analytics, neural networks and deep learning will also be introduced.

6. Analytics for Value Investing

This course examines quantitative models used by securities investors and asset managers to identify and interpret patterns in accounting data for making value-based fundamental investing decisions. The course will involve writing programming codes to analyse large-scale archival data, draw inferences from the statistical results, and back-test the models for their predictive power. The skills taught in this course would be useful for students who wish to pursue a career in securities investing, asset management, investment analytics or financial consulting.

7. Audit Analytics

This course examines the application of data analytics in audit based on an underlying risk-based methodology with real-life examples. Students will also learn about practical aspects in the audit analytics process such as extraction, transformation and loading of data as well as the actual execution of audit analytics tests and visualisation of the results in software such as Tableau and/or Qlikview. By the end of the course, students, in their respective groups, are expected to conceptualise the application of audit analytics in real-life companies through development of prototype dashboards.

8. Auditing Information Systems

Information systems provide core business functions and hold essential and sensitive information critical to successful business operations. IT Auditors must understand the concepts of information systems development, operation, data management, and the range of relevant and essential controls to ensure the timely delivery and integrity of business processes and the protection of business data. This course provides an understanding and assessing of the primary controls required to manage the business and information security risks of business information systems. The course is structured around the five domains of knowledge for the Certified Information Security Auditor (CISA) qualification.

9. Blockchain Applications in Financial Services

This course explores blockchains and smart contracts in the context of financial services. The fundamentals of blockchains and smart contracts are first explained and then the similarities and differences of public and private blockchains are shown. Various blockchain platforms are considered as well as the end-to-end implementation of a range of services, for example supply chain financing. The course has hands-on development, deployment and execution of smart contracts using Solidity for Ethereum and the FISCO BCOS blockchain platform. Emphasis is placed throughout the course on analysing real-world situations using case studies and gaining hands-on experience with financial systems.

Accounting Analytics Capstone (Pillar 3)

10. Accounting Analytics Capstone (SMU-X)

This SMU-X course offers an experiential learning opportunity that allows students to translate classroom knowledge and theory into practical solutions for real organisations. Through this student consultancy project, students learn how to solve complex business problems with guidance from the faculty and project sponsor mentors, from problem definition to final client presentation – while simultaneously testing their skills in real world settings. The course will focus on examining accounting processes and applying data-driven analytics and insights to identify and create accounting delivery efficiencies.

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