



The Professional Accountant's Role in Data

DISCUSSION PAPER

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Over four decades, IFAC has represented the global profession and supported the development, adoption, and implementation of international standards that underpin the contributions of today's global accountancy profession. IFAC has maintained a long-term approach to building and strengthening a global accountancy profession that supports transparent, accountable, and sustainable organizations, financial markets, and economies. ifac.org

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Foreword

As the world accelerates into the fourth industrial revolution and its emphasis on digitalization, organizations of all sizes and across all sectors face enormous disruption – but also opportunity. To thrive in this new digital economy, data and the proliferation of information must be strategically harnessed and utilized to drive more informed decisions that create better outcomes for customers, employees, investors, society and other stakeholders.

New approaches, processes, and models are needed to address the challenge of working with structured and unstructured data from different sources and provide the quality insights needed for decision-making that leads to both profitability and sustainability. Failure to understand and properly manage data could not only leave businesses behind, but potentially leave them without the capacity to meaningfully contribute in an increasingly global digital world.

Professional accountants, in their many roles, are uniquely positioned to meet the challenges of disruption. They need to support organizations as they navigate the uncertainty that accompanies this technological and economic transformation. By building upon core competences and expanding skills and knowledge to fulfill key roles in the data management value chain, not only can accountants secure a strong and vibrant future for themselves in the digital economy, but we can shepherd organizations across sectors and industries to adapt and even forge new paths with integrity and longevity. This report outlines our way forward.



CEO
CPA Canada



CEO
IFAC

Executive summary

The volume of digital data is exploding worldwide. In 2020, digital data was estimated to total 40 zettabytes (40,000,000,000,000 gigabytes), up from just 1.2 zettabytes in 2010. Incredibly, ninety per cent of this data was created in the last year and total data volume is expected to double every two years.

In today's economy, data is not only a commodity, but an asset that holds the key to unlocking powerful insight-driven decisions. But like any massive change, the data revolution is not without its challenges. Regulatory standards have not kept pace with the emergence of this valuable new asset. The weak legal and regulatory environment is affecting everything from our global transition to a digital economy to the profitability and sustainability of individual businesses. Significant risk exists that illegal or unethical activities may be committed due to a lack of a framework to educate data users and to regulate and enforce laws.

Leaders from all spheres — world, regional and business leaders — are looking for help to frame expectations, monitor activities and leverage data to promote profitability and prosperity.

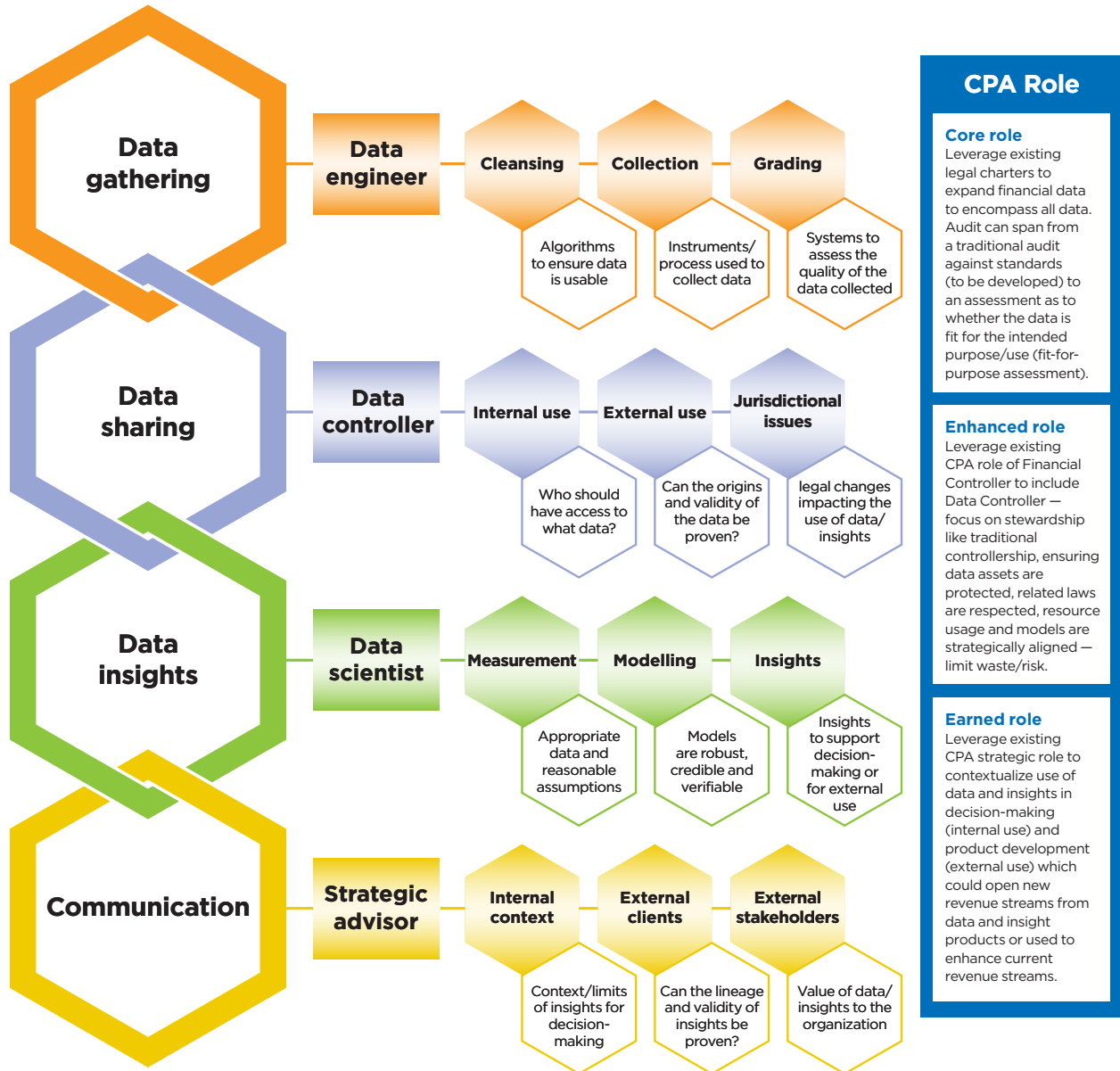
In this environment, professional accountants have the opportunity to position themselves to support leaders in developing much needed new standards and frameworks.

The growing recognition of data as an asset is also redefining the traditional concept of value chains. A new model called the data management value chain has emerged (see [Figure 1](#)). Data value chains differ from traditional value chains, which typically produce products or services. Data management value chains are about creating outcomes. Data-driven outcomes can range from an evidence-based organizational strategy to an artificial intelligence solution with self-learning that performs routine decision-making.

Professional accountants need to adapt to continue to provide strategic contributions as value chains evolve from an industrial to a digital economy. While professional accountants have always dealt with data, their professional expertise can be predominantly focused on structured data sets, which are no longer the norm. That said, professional accountants can leverage their existing expertise and expand their approaches to include both structured and unstructured datasets that capture financial and non-financial data to support organizations in making insight-driven decisions that seize opportunities and

respond to risks. However, to do so these professionals must supplement their existing competencies with the additional skills and knowledge required to fulfill key roles in the data management value chain.

Figure 1: Data management value chain



The data management value chain consists of processes that begin when data is first created and includes storing, transforming, analyzing and communicating data so that users can make sense of and benefit from its insights. This report explores how a professional accountant's expertise can be applied in the following four key roles that are integral to the data management value chain:

1. **Data engineer:** ensures data used has integrity, is clean and reliable
2. **Data controller:** focuses on the stewardship of data resources in the same way as the existing controllership role (stewardship of financial and physical resources)
3. **Data scientist:** analyzes and interprets complex data to develop insights to support decision-making
4. **Strategic advisor:** frames, analyzes and explains complex business issues within a local, national or global context based on the strengths and limitations of the data, and on the assumptions and models that underpin derived insights



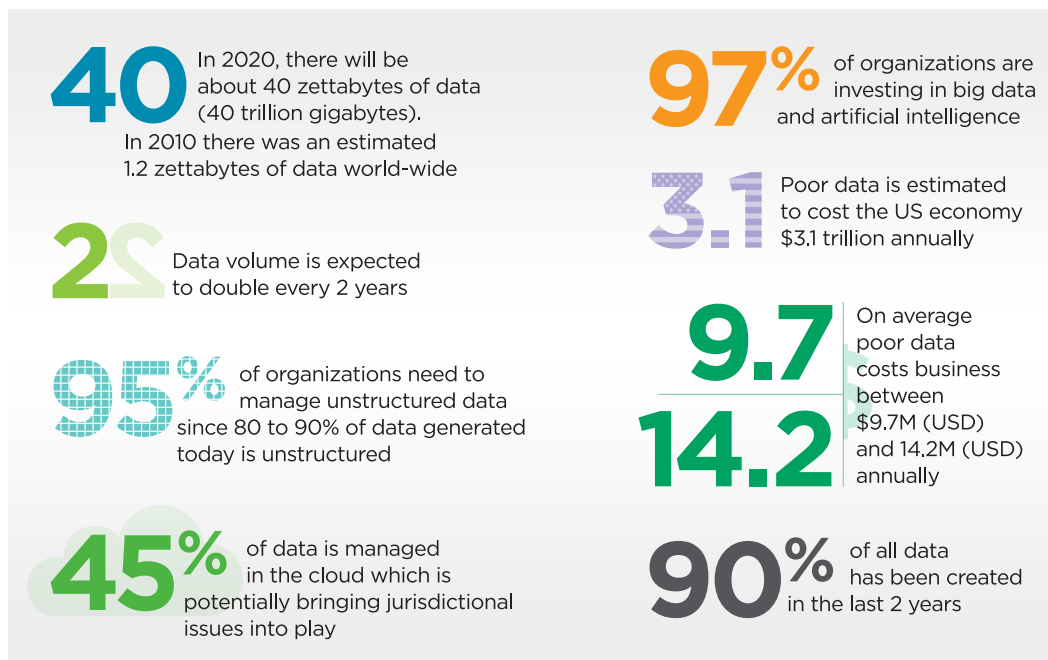
Introduction

Is data a commodity or is it more like an asset that grows in value as it is used? In truth, it is both. And as data creation explodes through the global economy, this dichotomy is creating new challenges and opportunities for professional accountants and others who are being called on to oversee, manage and measure the value of data.

The 2019 United Nations [report on the digital economy](#) emphasized that technology is driving a wholesale change in economies worldwide. Massive growth in data is mirrored in the expansion of big data analytics, artificial intelligence (AI), cloud computing and digital business models and platforms. More devices access the internet, an ever-increasing number of people use digital services, more value chains are digitally connected and digital technologies continue to grow. McKinsey & Company recently published a [paper](#) that argues that COVID-19 has accelerated this transformation by five years.

Access to data and the ability to transform data into digital intelligence have become crucial for the competitiveness of both countries and companies (see [Figure 2](#)). Will more data yield better decisions? Will it enable new revenue streams, such as from the sale of data and insights? Clearly there are examples of successes, but business literature is also full of failures.

Figure 2: Excerpts from a recent techjury blog



The key may lie in access to talent. McKinsey estimated that the world-wide digital economy would require almost three million people with data analytics skills by 2020. Yet, in 2015, RJMetrics estimated that there were less than 20,000 qualified and skilled data scientists worldwide.¹ A [data primer](#) published by the Chartered Professional Accountants of Canada in 2020 argues that professional accountants can and must step up to help fill the gap in these new roles.

In many ways it is a natural evolution. Accountants have always used financial data to measure performance for decision-makers and stakeholders through analysis and reports. Historically, professional accountants' core mandate has been to ensure that financial information is presented in a consistent manner and that a framework with standards is in place to ensure that people relying on the work of an expert are not misled. This professional foundation gives accountants an exceptionally strong footing on which to transition to leadership roles in managing and overseeing digital data. Nevertheless, it is still a significant transition. The professional accountant's traditional toolkit must evolve to address the volume, velocity, variety, and veracity of data, and to be able to leverage its value.

Governments around the world are racing to update their laws and create frameworks to best manage the digital economy. Organizations meanwhile scramble to build their expertise. Many are collecting and commoditizing data to create revenue streams through new services and products, with varying degrees of success. Digitally savvy technology giants like Apple, Google and Amazon are leading the pack with their focus on expanding their business models into new areas such as banking and healthcare, while one-time upstarts like Uber and Airbnb have created disruptive new business models that revolutionized entire industries — and the trend continues.

Professional accountants, through their roles as advisors and as members in industry, are well positioned to help organizations across all sectors and industries forge new paths in the digital economy.

¹ *ibid*

The digital economy is a new frontier

Digital data is both a commodity that can be bought and sold and an asset that can be used to generate insights for key business decisions. Yet, data standards to frame this new frontier are in their infancy. As a result, the legal, regulatory and ethical environment is unclear and this lack of clarity is impacting digital transformation globally. Opportunities may be lost when expectations are vague or imprecise. More significantly, potentially illegal or unethical activities may be undertaken inadvertently because expectations of behaviour or process have not been properly articulated.

Governments worldwide are developing legal frameworks to govern the digital economy but the creation of standards over data management is challenging. These challenges are exacerbated by cultural differences related to the perception of public good. Governments and trade associations have authorized different standard-setting bodies to propose data-gathering and usage approaches for their jurisdictions. The varying approaches and differing perceptions of public good are creating an uneven patchwork of frameworks within countries and internationally.

Many standard-setting organizations are keen to work with professional accountancy organizations to learn from the profession's expertise in standard setting and audit and assurance. At the same time, existing accounting standards also need to evolve to better address digital data. While current accounting standards reference the use of data in financial reporting, this must be augmented to provide clarity on how that data is to be gathered, analyzed and reported on. Clarity is also needed on expectations related to the use of data when a given standard references the use of data in disclosures.



Data management value chain

When discussing the role of accountants in data, it is important to understand the concept of data management value chains. The data management value chain is similar to other value chains, such as those in manufacturing, in that it breaks down the process into various subsystems, each involving inputs and outputs. How these systems and inputs and outputs are managed affects the quality, cost and, ultimately, the success of the final product in any value chain. There is one key difference however: in the data management value chain the final product is most often actionable insights rather than a tangible product or service.

Data management value chains are about creating data-driven outcomes. Examples of possible outcomes could range from insights to guide development of a new product or business strategy, to the streamlining of a specific workflow with an artificial intelligence solution that performs routine decision-making. A data management value chain (see Figure 3), consists of processes associated with gathering, sharing, analyzing and communicating insights arising from data.

Through its [Foresight Initiative](#), CPA Canada identified three categories of professional accounting roles within a *traditional value chain*:

- **Core role:** derived from the legal charters underpinning the profession, accountants are mandated to confirm financial data and that financial information has been fairly presented according to norms and standards
- **Enhanced role:** focused on stewardship functions related to the financial and physical resources of the organization; required to ensure that only those with appropriate access use the organization's resources for legitimate purposes
- **Earned role:** a strategic advisor integrating multiple perspectives to provide context for the financial information presented to decision-makers or communicated to stakeholders.

In the *data management value chain*, the functions that accountants play in each of these categories must transition to reflect the nature and use of digital assets (see [Figure 3](#)). Some aspects of traditional accounting roles become less relevant in the data management value chain, while the importance of other roles is enhanced.

As in finance, the roles of professional accountants in the data management value chain are varied. These roles may focus on specific aspects of the value chain and not the entire process, or they may extend across the entire value chain in a data governance, oversight or strategic capacity. In most organizations, the finance and accounting function likely does not 'own' all the data held by the organization, but it should be accountable for analysis that incorporates both financial and non-financial data, especially if the data is used to make decisions and incorporated into external communications.

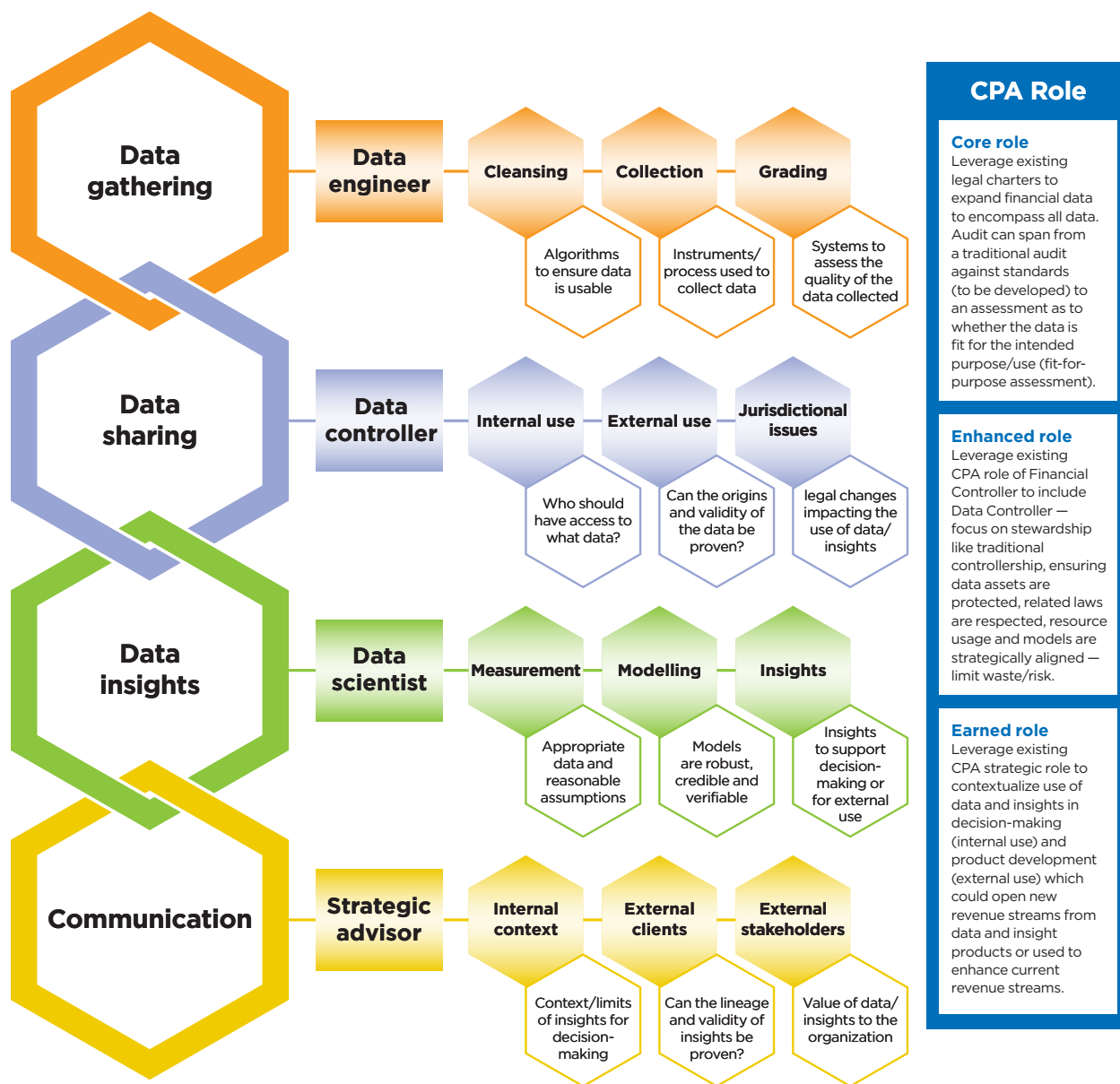
It is helpful to understand the four key roles at play in the data management value chain and how professional accountants can perform in these roles. While some of the terms used to describe these functions may seem to place them outside the expertise of professional accountants, most can be effectively filled by those with a professional accountant's experience and training.

The four roles are:

- **Data engineer:** ensures data used has integrity, is clean and reliable
- **Data controller:** focuses on the stewardship of data resources, similar to the traditional controllership role (stewardship of financial and physical resources)
- **Data scientist:** analyzes and interprets complex data to develop insights to support decision-making
- **Strategic advisor:** frames, analyzes and explains complex business issues within a local, national or global context based on an understanding of the strengths and limitations of the data, and the assumptions and models which underpin derived insights



Figure 3: Data management value chain



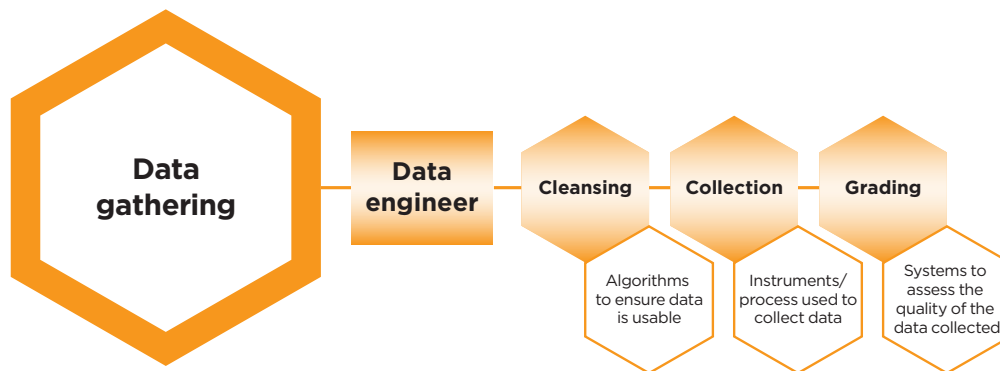
Data gathering

The overarching role within the data gathering process of the data management value chain is identified as a **data engineer**, which covers data collection, data cleansing and data grading. A data engineer is responsible for ensuring the data being used by the organization is clean and reliable. Additionally, data collected needs to adhere to a patchwork of frameworks

worldwide and even within countries. Of particular concern is the collection of personal information and care must be taken to ensure jurisdictional boundaries are respected.

While labeled a data engineer, the function does not need to be carried out by an engineer. It is essentially about ensuring data is fit-for-purpose and there are various roles for professional accountants within this phase of the data management value chain. The case studies included as annexes to this document provide practical examples of how professional accountants can fill these roles in routine reporting ([Case Study 1](#)), enhanced decision-making ([Case Study 2](#)) and with the adoption of artificial intelligence ([Case Study 3](#)).

Figure 4: Data gathering



Cleansing

Dirty data is of limited analytical value; however, it can be used to check for compliance with the adoption of internal policies. Checks and balances are required to ensure that the data has been appropriately cleaned and documented prior to analysis. Certifications will be required that the data has been reviewed and is complete and reliable. This includes ensuring that blank fields have been completed, duplicate records have been deleted and other actions have been taken to ensure the integrity of the dataset.

Collection

These processes are focused on mapping data from source to repositories that can then be used. It should include a thorough review of transformation processes, harmonization activities and final processed output. The function varies depending on whether data collection processes are automated, originate from sensors (i.e., from the internet of things) or manually entered into a database (i.e., a purchase order).

Grading

Grading is about determining whether data is appropriate for the purpose for which it will be used. Not all data is equal and different decisions require different levels of data reliability. Using data without understanding its reliability limitations can result in a poor outcome, particularly where the data is assumed to be more reliable than it is. However, it can take time and money to collect highly reliable data so requiring it for all decisions may result in missed opportunities.

To illustrate the idea of fit-for-purpose, data underpinning external reporting is of high reliability and is typically certified as such. Conversely, data used for internal purposes can be of varying reliability. Professional accountants need to understand the differences and be able to inform decision-makers of the reliability of the data underpinning a decision. This includes an assessment as to whether the data aligns with the data reliability requirements of a decision point. For example, an “options analysis” data reliability requirement is less stringent than a “go/no-go” decision point. Calibrating data reliability to decision-points can improve timeliness in decision-making, risk disclosure and transparency. Formalized check-in processes to ensure that decisions are validated as data is updated are essential; otherwise previously sound decisions may be overtaken by subsequent events.

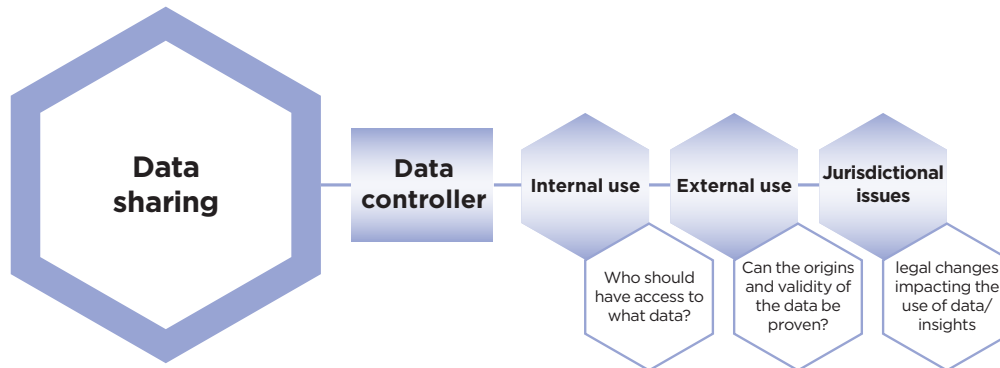
Potential role of professional accountants in data gathering

A core role of professional accountants in a digital economy could be to expand their audit and assurance role to include non-financial data. Internal controls for data management will need to be implemented for data collection, cleansing and grading. These controls will be essential to ensuring that corporate policies and jurisdictional boundaries (if/when developed) are respected. Additionally, professional accountants can test datasets to ensure they meet the criteria for different decision points. If the dataset is not aligned, appropriate disclosures need to be made to ensure decision-makers understand the limitations of the dataset and any subsequent assumptions underpinning the analysis. To illustrate this point, Canada’s federal government has implemented a [requirement](#) that its chief financial officers attest to the appropriateness of the dataset underpinning recommendations related to complex capital acquisitions. Moreover, internal controls related to data gathering can ensure the integrity of financial and non-financial data to promote accountability and prevent fraud.

Data sharing

The overarching role within this portion of the data management value chain is described as a **data controller**. The data controller's role is broader than that described in the EU's General Data Protection Regulations.² The data controller is responsible for the stewardship of data: to enhance the value of data through its protection, curation and appropriate use.

Figure 5: Data sharing



Internal use

Traditionally, controllers protect resources and ensure that only people with the appropriate access rights (need and permission) are authorized to use the resources. Professional accountants have traditionally performed stewardship roles in relation to financial and physical resources. In this capacity, they ensure that the financial resources of the organization are protected, related laws and requirements are adhered to and that activities undertaken by the organization are strategically aligned. The data controller's stewardship role is not limited to financial resources. It applies to all data resources and will overlap the financial controller's role to some extent. It is a natural evolution for professional accountants to broaden their traditional financial stewardship roles to include all data. Stewardship does not mean ownership. Non-financial data owners will often be the line functions within an organization. Stewardship is an enabling function to ensure that the data owners protect, curate, share and use the data according to external (laws, regulations, etc.) and internal (policy) constraints.

External use

As markets are created for data (general commercial exchange of data between buyers and sellers), it is expected that formal requirements will be developed for data that is sold, shared or traded to be certified.

² <https://gdpr-info.eu/>

The certification will likely entail the ability to prove the accuracy and source of the data, also known as provenance or lineage. A data controller would likely be called upon to provide this certification.

Jurisdictional issues

Organizations have significant opportunities to use new technologies to their advantage. This can raise significant legal and ethical challenges as not all uses of technology align with the values of different societies (fairness, security, privacy, understandability and transparency). As stated in the [International Code of Ethics for Professional Accountants](#) (the Code), taking into account their position and seniority in the organization, professional accountants are expected to encourage and promote an ethics-based culture in the organization — and as such are well-positioned to help organizations in the data controller role.

The appended case studies explore practical examples related to data sharing, incorporating data stewardship and ethical challenges. [Case Study 1](#) discusses how budget status reporting is driven by cost factors and how there may be sensitivities related to the access and use of this cost information (i.e., salaries). [Case Study 2](#) discusses the use of external information in decision-making while [Case Study 3](#) discusses how to ensure artificial intelligence implementations respect stewardship functions and ethical expectations.

Potential role of professional accountants in data sharing

The key element of the data controller's role is to protect the data. This involves ensuring that:

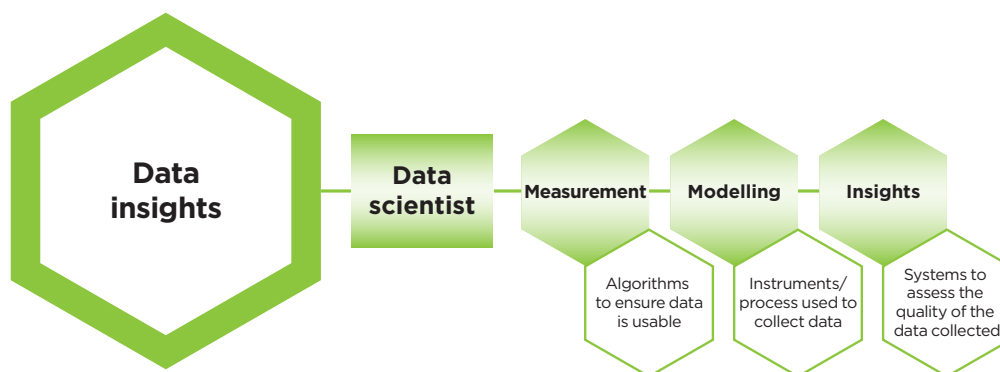
- only authorized individuals have access to the data
- the origin of the data can be demonstrated
- data is used for its intended purpose

An enhanced role for professional accountants is to ensure that jurisdictional boundaries are respected through appropriate monitoring of data usage. An equally important role is to certify that the data being used or sold is fit-for-purpose, in that the lineage and provenance of the data can be proven.

Data insights

The overarching role within this portion of the data management value chain is often labeled **data scientist**. A data scientist typically analyzes and interprets complex data to support organizational decision-making.

Figure 6: Data insights



Measurement

To generate insights through a model, the data underpinning the model must be in a form that the model can use. In some cases, the data will need to be converted into a common structure or format. A simple example is converting all currencies used in a model to U.S. dollars. More complicated conversions may involve quantifying data that is intangible. Professional judgment is required for these situations and any assumptions need to be clearly laid out so that insights derived from the analysis can be considered in light of key assumptions.

Additionally, the data must be analyzed to ensure that it is appropriate for the analysis to be undertaken. This is best illustrated through an example. In 2016, the director of cost estimating for NASA was describing their experience estimating costs for recent space launches. The insights arising from the model were not reflecting the actual costs of the launch. The model was checked and found to be appropriate. However, it was determined that the data underpinning the model was no longer reliable because there had been a transformation in technology that impacted the characteristics of new space vehicles. Through various data analysis techniques, NASA learned that data from the 1960s adjusted for inflation was more indicative of the costs of new space launches. In this case, the assumptions of aligning the old data to the current timeframe were key assumptions which would need to be disclosed with the insights.

However, data is not always available internally. If the required data is not available internally, data scientists will need to source the data from external sources. Ideally, externally sourced data will be a perfect input for the analysis. In circumstances where the best available (or most affordable data/insights)

are not perfectly aligned to the analysis, adjustments will need to be made to the data to ensure that it is fit-for-purpose. These adjustments will also need to be disclosed with the insights.

It is clear from the above that data reliability, while not a new concept for professional accountants, will require new approaches and different thinking. Traditionally, data used in financial analysis and reporting is very reliable with little uncertainty. Clearly, taking data from 1960 and adjusting it for inflation to use in 2016 will introduce significant uncertainty. This uncertainty needs to be understood, assessed and incorporated into models. At times, less reliable data will need to be used for a decision because it costs time and money to collect better data (if it is even available). Less reliable insights now may be more important than better insights after the decision has been made.

Modelling

In providing insights, the professional accountant will perform a data scientist role in that they will build or lead the building of models that use data to develop insights to inform decision-making. Modelling can range from simple spreadsheets to complicated artificial intelligence solutions that incorporate deep learning and other yet unknown techniques.

There are situations where multi-disciplinary teams of experts are needed to develop the insights. For example, when insights are developed for sale to others and not for internal use. Models will need to be documented and their key controls identified, tested and monitored for ongoing alignment.

Chief data officers are typically employed to help organizations identify strategic issues that could be solved or better solved through more complex data-driven models. Complexity is becoming increasingly common, especially with transitions to real-time reporting. It should be noted that complex and complicated are not the same. Complicated problems might be difficult to solve, but once they are, they stay solved, and learning is transferrable. Complex situations involve interaction between dynamic and sometimes hidden forces or trends where there might not be a right or wrong solution, therefore professional judgment and adaptation are needed to manage the challenge.

Real-time reporting will likely make complicated problems more complex. Professional accountants have a unique opportunity to guide the emerging shift from periodic to real-time measurement and reporting. Policies, datasets, models and assurances will be required to provide confidence to decision-makers and users that the insights arising from the analysis can be trusted.

This shift will in turn require transformation of accounting and assurance methodologies and standards. This transformation is discussed in the Chartered Professional Accountants of Canada's *Value Creation Primer*.

Insights

To understand the insights generated through models, users need to understand the data that underpins the model. Decision-makers may not need to understand the details of the data, but they do need assurance that the data used in the model is fit-for-purpose. If the data was not fit-for-purpose, but it was the best available data, decision-makers need to understand the limitations of the data and the assumptions that have been made to resolve these limitations.

Many organizations are interested in selling the insights they are developing. Some of these insights could be used to enhance the profitability of other organizations (i.e., used as inputs to their models). Insights may open new business models, which could result in a complete reshaping or evolution of the organization. For example, while John Deere still produces farm equipment, it has been including sensors on this equipment for a number of years and is now selling insights from these sensors to help farmers optimize their yields.

[Case Study 1](#) describes how the chief financial officer can de facto satisfy the chief data officer role using internal data. [Case Study 2](#) discusses how external data can be integrated into decision-making and [Case Study 3](#) describes how a chief financial officer can help a chief data officer with an artificial intelligence implementation.

Potential role of professional accountants in data insights

The enhanced role for professional accountants in data insights relates to ensuring that credible measurement activities underpin models. This role is multifaceted. It ranges from ensuring that data is fit-for-purpose, that assumptions are clear and reasonable and that the controls used in the models have been developed, tested and monitored. In artificial intelligence, professional accountants can endeavour to ensure that the model's insights are strategically aligned and remain so, particularly with self-learning models. Professional accountants can also ensure that models remain tactically aligned with corporate data policies and other jurisdictional constraints as they evolve.

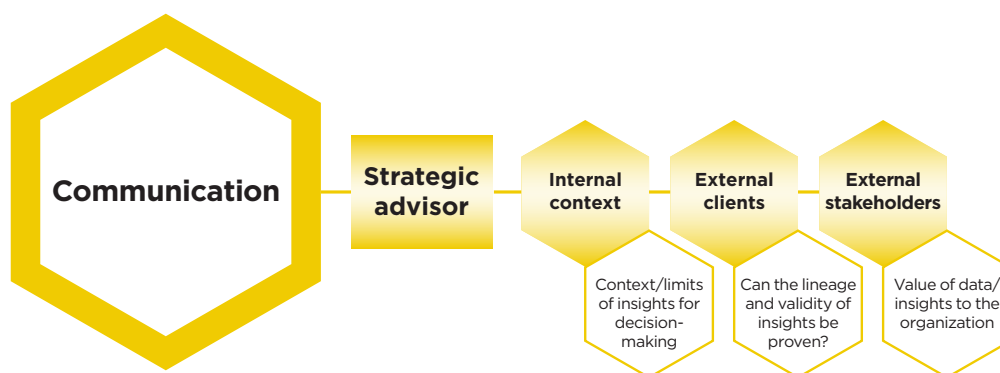
Professional accountants can earn the role of the chief data officer by establishing their credibility through competence in data management. By leveraging their role as a strategic business advisor integrating various perspectives, they can ensure that multi-faceted solutions based on credible

measurement are developed for strategic opportunities. Further, professional accountants will be able to attest that organizations have appropriately curated their datasets to support the analysis. Additionally, if outside datasets (data or insights) have been secured to support analysis, professional accountants will need to confirm that the datasets are relevant, reliable and verifiable. Professional accountants can also assess if there is a market for the sale of insights, including a robust risk/reward analysis.

Communication

The key role within this phase of the data management value chain is that of **strategic advisor**. A strategic advisor is typically responsible to frame, analyze and explain complex business issues within a local, national or global context based on an understanding of the strengths and limitations of the data, assumptions and models that underpin the insights. In essence, effective strategic advisors are strong storytellers who drive focus on relevance and create value through selected insights. The flood of data and its many insights will not help as much as a strategic advisor deciphering the insights and recommending next steps.

Figure 7: Communication



Internal context

To perform as effective business partners in the digital economy, professional accountants need to be strong communicators able to exercise their professional judgment. Data is ubiquitous and its prevalence is expected to increase exponentially. More data does not necessarily make decision-making easier. It can instead introduce distractions and exacerbate bias. For example, automation bias is the tendency to favor output generated from automated systems, even when human reasoning or contradictory information raises

questions as to whether such output is reliable or fit-for-purpose. To support professional accountants' understanding of bias and its impact on professional judgement, IESBA will be updating the Code to include examples of bias.³

Professional accountants will need to develop the skills to communicate key dataset limitations, including key assumptions to simplify decision-making. They will need to understand how decisions are made and be prepared to address bias and other human factors in decision-making. Otherwise, potential conflicts between decision-makers' intuition and models' insights may result in impasses and lost opportunities.

External clients

Additionally, professional accountants have a role to ensure that the models are sufficiently well documented to allow data lineage tracing of insights that are being offered to external clients. This will entail documenting the key controls associated with the analysis of the data, testing the design of these controls and then their effectiveness. An ongoing monitoring strategy will also be required to ensure the integrity of these insights, particularly if the model is self-learning.

Certifications will likely be required to confirm to purchasers the data provenance of insights. These certifications could be complex. They will likely involve verification of the usage of underlying data by the originator and a co-commitment by the organization acquiring the insights that they will not use the insights for a purpose other than that for which they were acquired.

External stakeholders

Trust is an essential element to a professional accountant's ability to communicate with decision-makers. Trust in this context is based on two facets that professional accountants need to strategically address:

- trust in their ability to provide competent service (to do things right)
- trust in ethical decision-making and behaviour (to do the right thing)

Ethics drives trust, but disruptive technologies and potential mis- and dis-information may result in poor decision outcomes.

Selling or disclosing data and insights is dependent on trusted measurement, a skill that is central to professional accountants' credibility. Chartered Professional Accountants of Canada has produced a *Value Creation Primer* that discusses measurement of intangible data in detail. To date, a gap exists relating to measurement that meets technical validity and precision thresholds

³ https://www.ifac.org/system/files/publications/files/Final-Pronouncement-Role-and-Mindset_0-1.pdf

to support the development of data-driven insights. The ability to measure an organization's success at creating and protecting value will be a bridge that enables professional accountants to play a broader role in developing insights to support strategic decision-making or for external use.

[Case Study 1](#) explains how contextualizing non-financial data in routine financial reporting can enhance the relevance of the report. [Case Study 2](#) describes how explaining external data can enhance strategic decision-making. [Case Study 3](#) describes how lineage can be demonstrated to enhance the credibility of the insights arising from the adoption of an artificial intelligence solution.

Potential role of professional accountants in communication

The role of professional accountants in communication and as a strategic advisor will need to be earned. Professional accountants today are known for contextualizing data insights related to financial information. To continue to provide strategic contributions in the digital economy, professional accountants will also need to be able to establish the lineage of insights to demonstrate their reliability. Insight lineage will be dependent on the key controls associated with the artificial intelligence solution. These controls will need to be identified, documented, tested and monitored to ensure compliance with internal and external frameworks.

In essence, strategic advisors will need to discuss the integrity of the data and reasonableness of any assumptions underpinning the analysis (model) which yielded insights. Data integrity is multi-faceted, crossing all elements of the data management value chain. It is derived from the processes and systems used to assess the integrity of the data collected in the data-gathering stage. It is also dependent on the documentation to establish the origins and reliability of the data during the data-sharing phase of the value chain. Within data analysis, data integrity applies to the measurement and modelling elements, in that measurements are credible, and models are robust, credible and verifiable. Finally, within the communication phase of the data management value chain, data integrity is based on whether the lineage and reliability of insights can be demonstrated.

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Appendix A

Case study 1 – Supporting routine decision-making using internal data

You are the financial controller preparing the monthly financial status report for your organization. You are concerned that it takes too long to produce the report and that by the time the report is ready the information is no longer relevant. In fact, the month-end report will not be seen until the following month, making it two months out of date.

This is accepted as the status quo within your organization, but it is not acceptable to you. You want the financial results to be reported more quickly because the information is key to informed, evidence-based decision-making. In the absence of timely financial results, you often lack the credible information needed to properly vet and challenge plans presented by other members of the executive team. You believe you are losing your credibility with the other executives as a result. More importantly, you fear your organization could make bad decisions because of ignorance.

You need to fix the process and at the same time provide relevant information and insights to the management committee. An ideal report would be automated, provided to the executives within five days of month end and provide evidence to support meaningful discussion of the organization's results against its plans and historical benchmarks. It only takes a half day to download the information from the financial system and run it through your model – why does it take two months to get to the management committee?

Strategic considerations for development of the enhanced report

You determine that your report needs to contain planned versus actual results for the financial information, which you can do – but just as important is what is driving the results. This means that in addition to the financial data, you will need data on the key cost drivers: the hiring and contracting activities. With this information, you will be able to enhance your model.

You figure that the new timeline to produce the automated enhanced report will be as follows:

- two days to close month end
- one day to run the report
- one day to test the analysis
- one day to approve and distribute the report to management

With the right data, this is a feasible timeline.

Data gathering

You need information from three separate systems to prepare the report. The financial system is under your control and it is the current source for the month-end report. However, you will need access to two other systems — the human resources system and the contracting system. You map out the data that you will need to build your model and test the report generation with the financial system.

Financial data is checked through automated processes to identify problematic transactions as they are entered and as part of the download to ensure that the financial system is in balance, all the records are complete and there are no duplicate entries. Accordingly, you are confident that the dataset is complete.

However, as you look at the financial data, you see other perennial problems. You know the salary forecast for two divisions is inaccurate and that significant contracting activity is not reflected in the information. Typically, the need to chase managers to update the records has been a major factor in the delay in getting the report out. You decide to get approval from the CEO that all executives need to certify at month end that all significant transactions have been recorded in the financial system. The CEO approves this process enhancement.

Data sharing

You have already determined that you need access to the human resources system to understand the attrition and hiring plans of the organization and the contracting system to understand contracting activity. When you approach the contracting group, they agree to provide an extract from their system. However, human resources will not provide the requested information citing data-privacy concerns.

You need to work with them and legal advisors to ensure that the use of the information will not compromise any privacy concerns. This is complicated because your organization does not have a formal corporate data policy, data

is in silos and access is granted based on individual interpretations of authority and appropriate use. Through extensive consultations, you secure access to the needed information and implement a series of internal controls to ensure that the personal information is appropriately protected.

Data insights

You adjust your existing model to generate benchmarks and include the planned versus actual results of hiring and contracting activity. You are also able to include executive certification of the integrity of the financial system as an annex to your report. You run your first report after having closed month end within two days. You confirm the integrity of the report and share it with the executives within five days of month end.

The enhanced report is timely and relevant. Within five days of month end, the executives know the status of actuals versus planned activities for financial results. They are aware of the key non-financial cost drivers of hiring and contracting activity and are now prepared to have a meaningful conversation about the monthly results. Through these conversations, new insights are revealed on what is impacting the financial results of the organization. Hiring and contracting delays are being discussed and the financial context is now understood, providing a basis for taking necessary action. Your credibility increases significantly with one report.

Communications

The report itself is impressive, but more important is your ability to explain it. You can integrate and contextualize the impact of contracting, hiring and other activities on the month-end results. You are also able to explain the model's limitations and its relevance to decision-making, further enhancing the strategic impact of the information. And as a result, the CEO is better able to make informed resource trade-off decisions and align the team around her vision.

Moreover, the organization is now better prepared to provide more timely, sophisticated and evidence-driven explanations to its stakeholders on its results and why these results have occurred.

Appendix B

Case Study 2 – Supporting enhanced decision-making with external data

Sales have been decreasing for the past three years. Faced with an uncertain future, your management team is looking for opportunities to diversify to increase sales. The chief operating officer (COO) recently presented a very favourable business case to the management committee that identified an expansion opportunity to sell the company’s existing products into a mid-sized city about 400 kilometers away. The management team is excited. Everyone is talking about how this could turn the company around and set it up for the next five to 10 years.

Strategic considerations for the development of the business case

You are a financial analyst working for the chief financial officer (CFO). She has asked you to review the business case and make sure it fairly represents the opportunities and threats. You have a look at it and see that the expansion is into a nearby city in another country. There is demographic information on the city that indicates it is like the city in which the company currently operates. You note in the risk discussion that there are currently no direct competitors in the proposed new location. The business case is logical and has been well researched. It includes a prudent perspective and assumes that the competitive environment will evolve to reflect your current environment, with two competitors emerging.

The business case assumes that revenue and cost information should be similar to your company’s current experience — it does not seem to present an overly optimistic scenario. You note that there are increased costs associated with the expansion’s impact to your supply chain, but these increased costs are offset by favourable exchange rates used in a sensitivity analysis of best, most-likely and worst-case scenarios. Under the three scenarios, the venture will be either more or at least as profitable as your existing operations. Overall, it is a logical and compelling business case.

The business case looks reasonable and you go back to the CFO and let her know that the analysis is convincing. She agrees; but redirects you. The business case as presented is a “no-brainer,” but she wants to know if the argument itself is reasonable. She clarifies that she wants you to look at the underpinnings of the argument to make sure that the data and associated insights make sense.

Data gathering

As you check the data underpinning the analysis you confirm that the census information used to identify the income levels and demographics of the population comes from official sources. However, when you check the attribution models on sales rates, they are based on metrics your organization established based on its experience in its current market. Given this market is in a different country, these assumptions may not hold. You were integral to the development of these metrics and know that they were based in part on the disposable income of different demographic segments within the city. You do more research and find some reputable sources that identify that the demographic cohorts in the expansion city actually have higher income levels than presented in the business case – the case is even stronger than presented.

Data sharing

You go see the CFO, who is impressed with your research and analysis. She asks you about the cost of living in the other city. Your answer that it is assumed to be the same as in the current market causes her concern and she asks you to confirm it. You continue your research and learn that the cost of living in the expansion city is higher than in your own. Housing and insurance costs exceed your existing market to the point where disposable income in the expansion city is less than in your city. Applying these insights to the business case reduces the sales model by 2.5 per cent – assuming the relationships remain the same. A 2.5 per cent reduction in sales is not good, but the venture would still be profitable under the scenarios provided.

You review the expense information and confirm it lays out all the expense categories of your current operations – everything is covered. However, in your research you learned that the expansion city is going to impose a small tariff on all businesses because the city’s infrastructure is deteriorating and needs to be renovated. The amount of the tariff is not known at this time. You discuss this discovery with the authors of the business case. They acknowledge that they were aware of the tariff, but because the amount was not known and expected to be small, they did not include it in the business case. You disagree with this

approach and include an estimate of its impact in the cost equation. This leads you to scrutinize the other costs and you discover that most costs will likely be different than what is presented. Some will likely be more while others are expected to be less — the net impact is about a 5 per cent decrease in the operating costs. You can support all your analysis with government and other reputable sources.

Looking at the exchange rate, it is based on an exchange rate from earlier in the year. When you ask about it, the business case authors agree and state that they believed this amount is more reflective of the exchange rate going forward. You research future exchange rates and find a reputable source that states a future exchange rate that is slightly lower than the one used in the business case. This may make the venture even more profitable. The exchange rate model, however, identifies that the exchange rate could fluctuate between an upper amount and a lower amount. You could either model the impact of the foreign exchange exposure or hedge to account for this risk and include the hedging costs in the business case.

Data insights

There is more uncertainty in the proposed expansion than implied in the business case — demographics, disposable income, cost of living, operating costs, the expected tariff and the exchange rate. You conclude that the current analysis is too simplistic; you need to account for the uncertainty in the analysis. To this end you hire data scientist consultants to develop a model to account for all these inputs and their expected variability. You subsequently test the contractor's model to ensure that it is credible, robust and repeatable by reviewing the internal controls related to the model. The insights from the model are shocking! It is possible that the company could earn an enormous amount of money through the expansion, but it is unlikely. Equally likely scenarios show that the company will be close to breakeven with favourable exchange rates or may lose money with unfavourable exchange rates.

Communications

The CFO asks you to present the findings to the leadership team. With the data you collected you can contextualize the model. The COO disputes your data and assumptions, saying that the business case was founded on data and experience. You explain in detail where the assumptions deviate and why. More importantly, you can quantify the impact of the various assumptions to the bottom line of the different scenarios. Management is now able to have a prudent conversation about the expansion based on a more careful

examination of risk/reward. Specifically, the management committee can understand which risks are controllable and which are not. Also, meaningful mitigation strategies can be developed to inform potential exit strategies based on leading indicators, rather than by reacting to financial information that quantifies potential profits or losses after they have been realized.



Appendix C

Case Study 3 – Supporting the adoption of artificial intelligence

Your company's management team decided to investigate an artificial intelligence (AI) solution that would enhance customer relationship management through real-time learning and automated decision-making while reducing costs (salary) and optimizing production mix profitability.

Strategic considerations for the adoption of artificial intelligence

The chief data officer (CDO) was tasked with the feasibility study of a sales/customer relations AI solution. A team of three data scientists was hired. This team spent a significant amount of time interviewing various employees and customers to understand how the company generated sales and interacted with its customers. Over time, they identified the core processes and how these processes could be automated to eliminate wait times for call-centre support personnel to engage with customers.

In testing, the AI was able to satisfy customer needs more often than control testing with human client-relations people. The AI was also able to upsell and cross sell products to clients better than humans. This was in part because optimization algorithms allowed the AI to determine the most profitable proposals to present to a client without needing to seek management approval of the proposal. These insights were based on client profiles, production capacity, cost information and human behavioural insights. The CDO also determined that the company could potentially sell AI insights to others, opening a new revenue stream that would have an incredible return on investment since investment costs were sunk.

The management committee is impressed with the proof-of-concept demonstration. The CDO is asked to develop an implementation plan. However, the chief financial officer (CFO) has concerns. She asks several questions during the presentation. The answers, while credible, do not reduce her worries. She had met with the CDO while he was developing his

implementation strategy. In this meeting, the CDO suggested that the CFO develop some scenarios to explore the potential profitability of selling of AI derived insights to others. Before agreeing to the scenario planning, the CFO wanted to understand the AI solution better to develop appropriate models. The CDO agreed to let the CFO's team explore the AI solution.

Data gathering

The CFO quickly learned that the AI solution was a generic AI solution that had been customized to meet company's needs by the data scientists. The data scientists had used five years of actual company data as a dataset on products, prices and costs. The company did not have relevant information on client behaviours, so a dataset was purchased from an outside source and fed into the AI solution to help the AI make sales recommendations to clients.

The CFO reflected on this information and was able to pinpoint her areas of concern. The AI was data driven; however, it was founded on a series of assumptions that may or may not be valid. These assumptions were implicit and had not been disclosed or discussed with the management committee. She pulled her team together and asked them to explore the following:

- Were the key controls related to the new process identified, documented and tested, and was there an ongoing monitoring strategy to ensure that the AI solution remained on track?
- The company data set used to educate the AI solution contained an inherent product mix and cost distribution. Is this product mix aligned with the future direction of the company? Can the AI change the product mix? If so, are there constraints on it; if not, how will the AI react to changes in the cost-allocation mix? Are capacity constraints and input costs included in the AI solution?
- Is the source of the client-behavioural data set that was purchased reputable and the providence of the insights certified? This data set was developed for a specific purpose; what is it? Is there an alignment between that purpose and the company's intended use of the insights?
- Is there an existing market for the insights or will the company be creating the market?
- Are there any existing legal or potential future regulations that may impact the selling of these insights to others? Could there be a negative impact to client perceptions of the company if it sells these insights?

Data sharing

The CFO's team reports back the following:

- The key controls in the AI solution are known, identified and tested and they are currently working as intended. However, the key controls are not formally documented, nor is there a plan to monitor them.
- The company's dataset has an implicit product mix, which is consistent with the intended strategic direction of the company. Capacity constraints are included in the AI solution so that the AI solution will not exceed the production capacity of the company. However, input costs are based on historical information. These cost assumptions may not be relevant if the AI solution changes the input mix to maximize profitability.
- The behavioural profile information is certified and is being secured from a reputable source; however, it is of a generic retail nature and not specific to our industry. As such, the insights may not be completely relevant. The AI solution has been adapted for differences between the intended use of the insights and our application of the insights, but these assumptions were not disclosed or discussed with the management committee.
- There is no existing market for our insights. The potential exists, but the market price of the insights cannot be determined. The CDO team used the price we paid for our behavioural insights as a proxy for the selling price of our insights. This may not be the case and may be overstating the benefit of selling insights.
- If we sell the insights, competitors may gain access to this information. If we scrub the information to the point where a competitor could not use the insights, we may dilute the insights to the point where they have limited value.
- More importantly, there are emerging legal issues around consent for secondary use that could impact our ability to sell this data. This presents an ethical issue about the selling of these insights being permitted now, but potentially disallowed in the future. Should we pursue the opportunity now, only to lose it in the future? The marginal cost of selling the data is low and the profitability is high in the short-term, but the long-term risks to the reputation of the company are not known. The company does not have a corporate data policy to guide its decision-making.

Data insights

The CFO distills this information into a report for the CDO. The CDO appreciates the assessment and agrees to work with the CFO to resolve the issues.

- Work is initiated to document the internal control environment of the AI solution and develop an ongoing monitoring strategy for the key controls.
- The key assumptions are identified and disclosed along with their potential impact to the AI solution. The most significant assumptions related to product mix, capacity constraints, input costs, cost allocation models and behavioural insights will be presented to the management committee for approval.
- The AI solution will be adapted to consider additional reputable and certified datasets to predict future input costs.
- A corporate data policy will be developed to support the AI implementation that details the company's accepted use of data and the parameters it must consider in order to sell data or insights.
- The risks and rewards related to selling customer insights are identified to better frame management's discussion of whether to proceed with selling this information.

Communications

By taking a broader view of her stewardship responsibilities beyond just financial information, the CFO was able to challenge the AI solution and ensure that a more comprehensive AI solution was developed.

Further, she was able to ensure that the management committee understood the risks and rewards of adopting the proof of concept. Specifically, the management team had better information to fulfil their mandate of setting and monitoring the strategic direction of the company and maintaining it as a going concern. The management committee is also positioned to understand the ethical considerations of selling customer insights and to make an informed determination as the risks/rewards of changing their business model.

Broadening a professional accountant's paradigm to include the non-financial information used in business decisions allows professional accountants to apply existing competencies in new contexts to add business value and strategic relevance.

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CPA

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CANADA

277 WELLINGTON STREET WEST
TORONTO, ON CANADA M5V 3H2
T. 416 977.3222 F. 416 977.8585
CPACANADA.CA