



The Data Intelligent Tax Administration

Meeting the challenges of
Big Tax Data and Analytics



Microsoft

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The Data Intelligent Tax Administration

This paper is a joint production of Microsoft and PricewaterhouseCoopers Belastingadviseurs N.V. the Netherlands and is the second in a series of publications addressing the digital transformation journey that tax administrations will need to embark on to help their countries' overall health and stability, economic growth and attractiveness to investors.

Compliance strategy

An overarching strategy for compliance management in the various taxpayer segments



2

Legislative framework

An enhanced multi-tax legislative framework



3

Operational framework

Design and principles of governance model and guidelines for core processes and procedures



4

Tax Technology & infrastructure

Tax Technology strategy, Software platforms and IT infrastructure Toolboxes for data analytics, PM



5

Change management

Training and education Behaviour change management



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Executive summary

Tax administrations today handle an unprecedented amount of information flow. As if the complexity of the tax system wasn't enough, they now find themselves collecting an ever-increasing amount of tax data coming from traditional sources along with digital ones such as digital payments, electronic invoicing and connected devices (e.g. online cash-registers and point-of-sale solutions). At the same time, many administrations are expanding their data collection capabilities even further into new areas, including third parties from online trading, asset leasing, payments to subcontractors and value-added tax (VAT) invoices.

Public and political forces believe this data can contribute to the betterment of society. Tax administrations also believe such data can help them achieve operational excellence. This is indeed possible, if these administrations can convert their collected data into actionable data insights. Therein lies the challenge.

Tax administrations often struggle to develop and implement a cohesive technology strategy with long-term measurable objectives, that can transform the ever-growing data 'tsunami' into actionable insights. In practice, they often turn to ad-hoc 'bandage' solutions with shorter-term siloed effects instead of farsighted data-driven strategies, which deliver operational excellence sustainably by uncovering the power of data.

A data-driven strategy empowers tax administrations to make decisions that benefit their own and their country's socio-economic objectives now and in the future. This paper helps define such strategies and outline their benefits for tax administrations around the world.

A data-driven strategy also plays into the General Data Protection Regulation (GDPR) that takes effect in Europe in 2018. This regulation has been characterized as a compliance and governance measure, but also covers new business creation and revenue streams. GDPR will disrupt and democratize data markets in several industries. Citizens will gain more control over their data and organizations that develop new business services based on such data assets will be big winners.

Please be advised that this is neither a scientific publication nor marketing material. The purpose of this publication is to provide 'food for thought' to the broad community of tax system stakeholders.

Introduction



Tax administrations today find themselves inundated with a never-ending stream of structured and unstructured data coming from multiple sources and channels. This is mainly due to the increase of:

- Global transparency initiatives (e.g. exchange of country-by-country reports between tax administrations)
- Tax data from mass media, the internet and third-party sources (e.g. banks, chambers of commerce, and stock exchange committees)
- Digital channel and new business models (e.g. mobile platforms, messaging apps, IoT, social media and bitcoins)

To address the influx of information, more and more administrations are looking to modernize their Big Data capabilities. This includes integrating data sources from other administrations such as social services as well as private entities such as banks.

Collection, however, is only part of the issue. Even more important is what tax administrations do with that data. Many struggle to gain insights from it. Furthermore, they face real challenges with compliance and safeguarding taxpayers' rights and confidentiality.

Secure data optimization has the potential to make a huge difference for taxpayers, tax administrators and the country. Effective data management empowers tax administrations with the ability to make sound, fair and quick decisions with less resources. It also lets them handle compliance processes quickly, improve taxpayer services, prevent tax fault/fraud and use predictive modelling to see the impact of macroeconomic trends and policy changes.

The question that will drive real benefits for tax administrations becomes less about how and why incorporate digital transformation and more about how to become data-intelligent organizations. Tax administrations can answer that challenge in two primary ways:

- **Operational excellence** that offers a clear strategy, proper infrastructure, competent staff and continuous performance measurement.
- **Technical transformation** that lays the foundation for relevant data management and actionable insights with the use of technology.

"Data analytics offers uncountable opportunities for tax administrations and poses new challenges in order to leverage efforts and investments." Jose Borja Tome, Deputy Director, IT Department, Spanish Tax Agency.

"We need to focus on the quality of information and our ability to use this information with the aim of increasing compliance. We need to focus on a legal framework that requires and facilitates collection and use of digital information." Nina Schanke Funnemark, Deputy Director General, The Norwegian Directorate of Taxes, Norway.

"Big data is an important source of information for tax administrations that will help them in detecting and evidencing mistakes and tax evasion and in carrying out their compliance approach." Caroline Edery, Head of Unit, European Commission, Directorate-General for Taxation and Customs Union.

Source: [IOTA, Data-Driven Tax Administration, 2016](#)



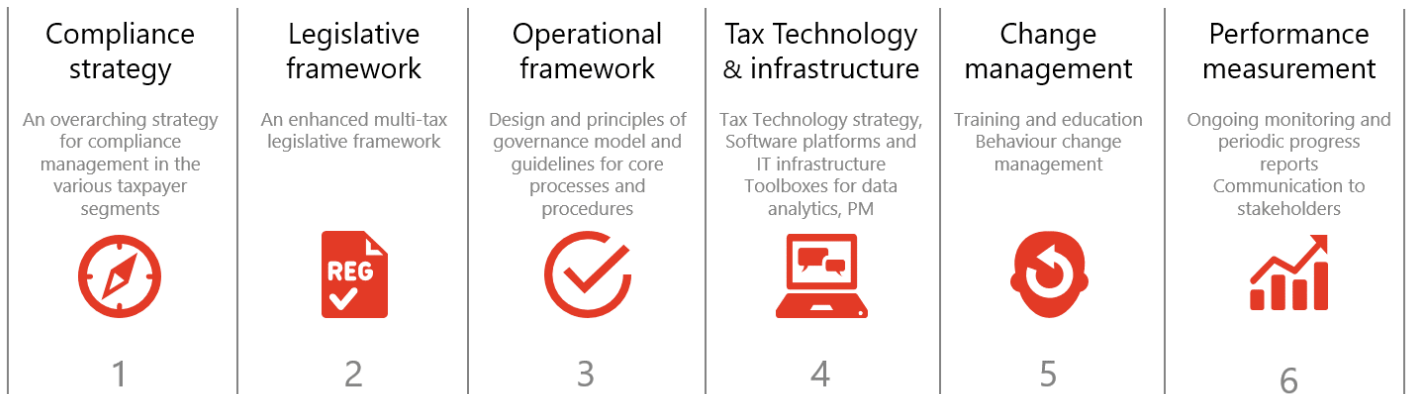
61.6%: 99.19

Using increasingly powerful data models and tools, we are able to make better use of our data-holdings to support our decision making, advise government and deliver outcomes with agility.

Source: [Australian Taxation Office, Corporate plan 2015-19](#)

72.48

Operational excellence



Key components of a successful digital transformation

Improving data intelligence involves taking a holistic approach that incorporates the above six key components of a successful digital transformation. These points were outlined in detail in our first publication, ['Digital Transformation of Tax Administration'](#). Here, we will solely focus on strategy and change management, both being key priorities for achieving meaningful outcomes through data collection and analysis.

Designing a clear vision and data strategy for the future

A detailed data strategy helps tax administrations clearly define their main objectives, develop key performance indicators (KPIs) tied to those objectives and prioritize initiatives. Having such a clear vision empowers them to make decisions that benefit their country's socio-economic goals. It also helps invest in the right technologies for insightful analytics and gives a foundation for those adverse to change within their IT departments and business units to keep an open mind about using new organizational models and acquiring new skillsets.

Successful data-driven strategy is a continuous and dynamic process that consistently focusses on the following:

- The vision a tax administration wants to achieve
- The resources allocated for successful implementation of change
- The measure of success
- The governance to dynamically adapt to changing circumstances (i.e. a new regulation pushed by a new election; a new business stream coming out)
- Ensuring and maintaining privacy and security

Such a strategy helps tax administrations reassess the process of data collection, data evaluation, data management, storage, building representative datasets, active searches for and integration of new data sources (internal or external) (structured or unstructured) and identification of taxpayer preferences, behaviour and risks.

Singapore: A massively parallel processing platform

Singapore has custom-built a centralized database for analytical purposes, which runs on a massively parallel processing platform. The database consolidates information from different sources and stores it in a format suitable for predictive modelling and other advanced analytics techniques, enabling staff to respond to organizational priorities in a more flexible manner.

Source: [OECD, Advanced Analytics for Better Tax Administration, 2016](#)

Areas addressed with a data-intelligent strategy

Tax administrations that effectively develop and deploy a data-intelligent strategy improve their efficiency and effectiveness by:

- Increasing taxpayer satisfaction and voluntary compliance
- Helping administrators better understand taxpayers
- Maximizing risk detection and intelligent audits
- Improving macro socio-economic predictability to close the tax gap

Most countries' tax agencies currently have implemented tools for reporting, business intelligence and dashboards as well as basic analytics for descriptive or diagnostic purposes. These resources help answer queries such as, "Why did this tax gap happen?" They fail to, however, provide key insight that comes from digital transformation tools such as:

- **Predictive analytics** that provide information on likely future outcomes or resource maintenance schedules
- **Prescriptive analytics** that calculate expected outcomes and help recommend the best course of action for decisions such as changing a tax regulation. This form of insight often includes the use of artificial intelligence (e.g. cognitive, context aware) and augmented analytics and optimization (e.g. pervasive, automation)

Taxpayers expectations in a digital world

A tax administration's primary function is to collect and enforce taxes. With a solid data strategy, tax administrations can ensure they deliver more efficient services to businesses and citizens, which in turn helps optimize compliance and drive economic output.

Most tax administrations find that their taxpayers have certain expectations that their administrations will incorporate digital technology into their services.



Examples of such services include the following:

- Simplified tax payments such as e-Services as well as digital capacity in cooperation with vendors and taxpayers (e.g. accounting, online banking, social media integration)
- Reliable, trusted and transparent data to complete tax transactions
- Data trust and transparency within an online, real-time display to simplify viewing, track the progress of their interactions, provide feedback in case corrections are needed and better understand how taxes contribute to the overall country's health.
- Receiving and accessing information more easily
- e-Services such as e-Filing deduction calculations instead of passive discovery options
- Service based on personalized requirements which requires knowing taxpayers well, including defining all internal and external sources of data to integrate with (e.g. Social Contribution Agencies)

Making the digital world an organic part of tax administrations requires improving identity and security solutions and delivering contemporary online tools/services in multi-channels for personalized, digital engagement with citizens.

A data-intelligent strategy can also help with transparency, which more and more countries and international organizations are using to decrease tax evasion and tighten the international community. Many countries are working on initiatives to share data securely within and outside of its borders. For example, the Organization for Economic Co-operation and Development (OECD) has been driving an initiative called [Base Erosion and Profit Shifting \(BEPS\)](#) to fight tax avoidance that exploits gaps and mismatches in tax rules between countries. More than 100 countries have already joined.

Mexico: increased intelligent data management through cloud computing

According to Juan Manuel Galarza, General Administrator of Communications and Information Technology at Tax Authority of Mexico, incorporating powerful data analytics tools has enabled the Mexican Tax Administration Service (SAT) to broaden its knowledge of taxpayers. This includes reducing process times for electronic invoices from many hours to as little as two minutes. When taxpayers access the portal, they now receive a pre-populated form for their electronic invoice after the system performs a full analysis of all past invoices issued, salaries, income, costs, and other information that they included in documents previously submitted to SAT. SAT is now able to analyze and integrate 10 million invoices in a matter of minutes.

Source: [Case study - Tax authority improves interaction with taxpayers through cloud computing services.](#)

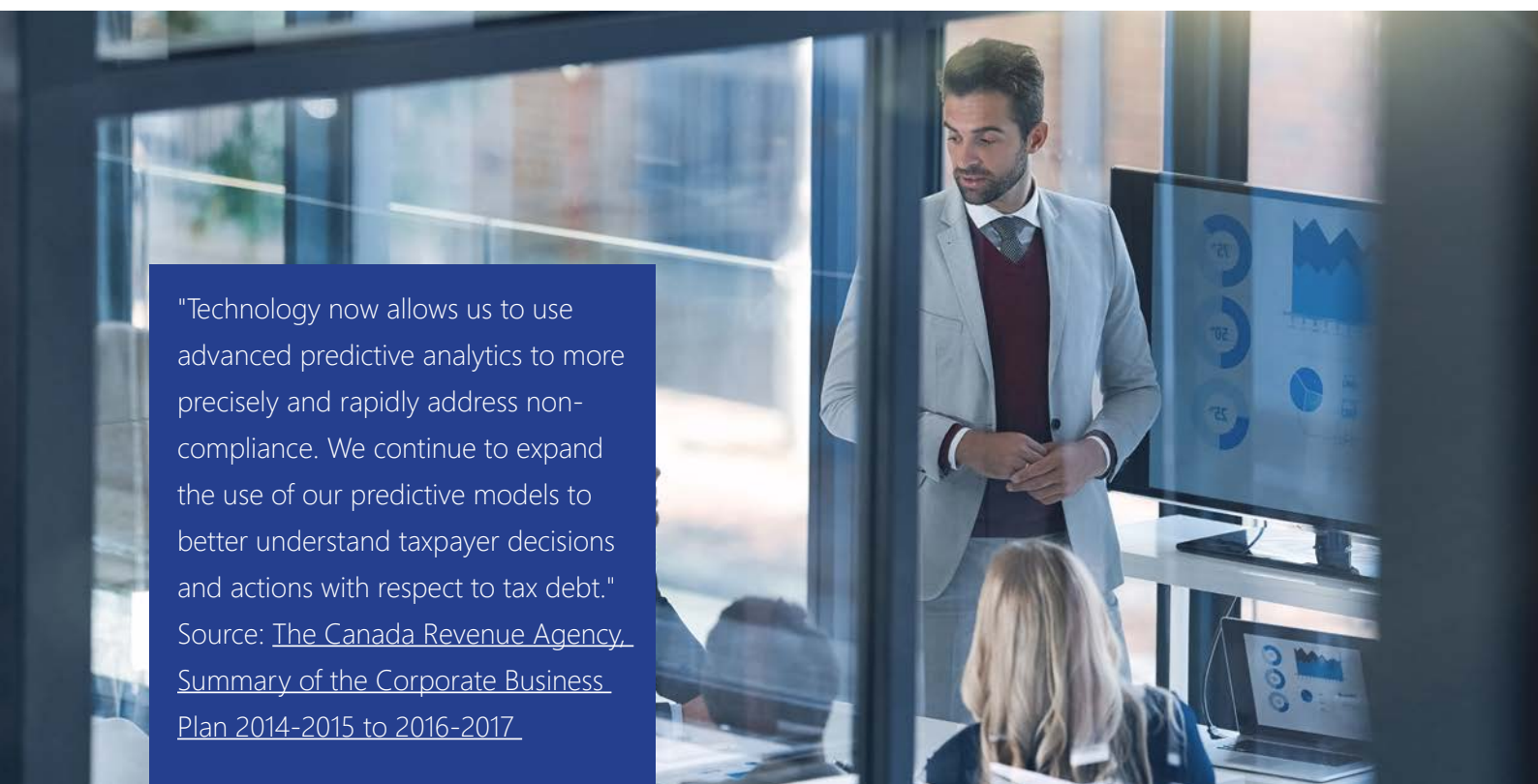
Many tax administrations actively work in that direction by pre-compiling filing with data integrated from various data sources (e.g. banks or pension agencies), or leveraging the use of technologies such as chatbots that facilitate the interaction with citizens or businesses. They also use self-service citizen portals and knowledge bases, which enable better response time to citizen inquiries and requests.

Maximizing risk detection and intelligent audit

Tax administrations are always looking for ways to detect new tax evasion behaviors and patterns, identify organized tax evasion networks or simply reduce errors. Data from diversified sources has helped data-enabled tax administrations enforce compliance and anti-fraud policies. This practice also provides effective tools to understand non-compliant behaviors, spot high-risk areas, predict fraudulent taxpayers or businesses and create proactive measures to avoid or deter.

A data-intelligent strategy can help tax auditors with **predictive modelling** for investigating errors and fraud or **predictive analytics** for risk evaluation (e.g. on VAT refund claims for non-residents). Benefits therefore include the ability to:

- Obtain a 360-degree view of a taxpayer by accessing insights from large datasets
- Detect fraud by integrating current data with Social Network Analysis
- Provide unsupervised learning methods to identify new, unknown types of risk and interesting/anomalous patterns in data
- Detect and remediate errors for filing and payment compliance
- Offer risk modelling and controlled experimentations to identify cases and/or taxpayers likely to fail and the interventions that can remedy the situation



"Technology now allows us to use advanced predictive analytics to more precisely and rapidly address non-compliance. We continue to expand the use of our predictive models to better understand taxpayer decisions and actions with respect to tax debt."

Source: [The Canada Revenue Agency, Summary of the Corporate Business Plan 2014-2015 to 2016-2017](#)

Various organizations such as the OECD confirm that advanced analytics can positively impact tax administrations in many scenarios:

- **Auditing.** Tax administrations can extract insights from large datasets, assess the next-best alternative, analyze social networks or predict unreported income.
- **Filing and payment compliance.** Analytics can change taxpayer behavior to increase compliance with programs for risk modelling and controlled experimentation in taxpayer communication.
- **Debt management.** Insight pertaining to debt can apply to companies that fail to pay.
- **Policy evaluation.** Tax administrations can better measure tax gaps or assess the impact of policy changes.
- **Taxpayer segmentation.** Tax administrations can identify groups based upon similarities on set criteria or predict response to intervention.

Singapore – Social Network Analysis

The Inland Revenue Authority of Singapore (IRAS) uses the enterprise-wide Social Network Analysis system to show relationships between people, organizations and various entities. The tool enables IRAS to enhance its capability in risk profiling and decision-making.

Source: [OECD, The Changing Tax Compliance Environment and the Role of Audit, 2017](#)

Improving macro socio-economic predictability to close tax gaps

The OECD's 'Changing Tax Compliance 2017' report highlights how advanced analytics use predictive and prescriptive approaches that incorporate statistical and machine learning techniques to **better inform decisions** about resource deployment, intervention and policy design. Such analytics give tax administrations the **agility to adjust** to new disruptive trends such as Bitcoin and **cope with change** driven by political, societal or economic priorities such as the ever-growing tax competition between cities and countries (e.g. tax heavens).

A number of Think-Tanks are challenging the existing tax paradigms such as 'the Ex'tax initiative,' which proposes radical tax changes such as raising taxes on natural resource use while lowering taxes on labor in order to create an incentive to save natural resources and a boost to manpower. Such policy changes obviously heavily require advanced analytics and predictive models to quantify the impact on GDP, employment, CO2-emissions and more.

Tax administrations can also use data insight to anticipate new revenue streams, which proactively disrupt existing businesses and business models (e.g. Uber, AirBnB). They can define how new regulations impact citizens by modelling expected outputs and enabling experimentation of the design or tax regulations that target specific sets of citizens or

businesses (e.g. the ability to incentivize value-add industries such as tourism). The result is countries can obtain a more reliable financial output as well as a better ability to tackle large, societal issues such as reducing carbon footprint or dealing with refugee influx.

Ireland – the Revenue Analytics Group

The Irish tax administration has established a senior management group — the Revenue Analytics Group (RAG) — to manage all analytics work in Revenue Ireland. The RAG consists of representatives from the business, analytics and IT functions. It also has a direct link to the key operational and IT governance bodies. By using advanced analytics, Irish tax authorities can identify cases for intervention, forecast revenue collections and evaluate the impact of actions and interventions. Source: [OECD, Advanced Analytics for Better Tax Administration, 2016](#).

Investing in change management capabilities

Establishing an effective data analytics team requires teaching new skills. For tax authorities, needed data skills are less about gathering and auditing data and more about using data analytics, data mining, forensic auditing, risk management and tax technology skills to make informed decisions.

When tax administrations explore how to build the necessary skills for their employees, they should focus on, in most cases, several strategies:

- Complex scenarios combining data from various sources and using machine learning and AI tools to identify fraud, forecast revenues, and maintain taxpayer compliance
- Data analysts who use data warehouse and analytics to produce insight for the management team of KPI metrics, assist in the planning of audits to maximize their efficiency, implement transparency and open-data initiatives, and consolidate and combine data from different sources to build a 360-degree taxpayer view

In general terms, chief data and analytics officers need to have teams with capabilities to cover topics such as:

- Integration of source data
- Data/metadata management
- Data cleansing
- Data consistency on all service delivery platforms
- Data governance and stewardship
- Data quality
- Data architecture (model and re-use)
- Data security
- Strategic decision-making based on data outcomes

As tax administrations transform their operations with technology to automate and embed tax compliance in day-to-day business operations with taxpayers, they also require strategic risk-management skills for profiling taxpayers for audits and efficiently allocating the appropriate resources. Many tax administrations are already re-evaluating their current talent needs against these additional capabilities.

Creating a strong ecosystem of cooperation

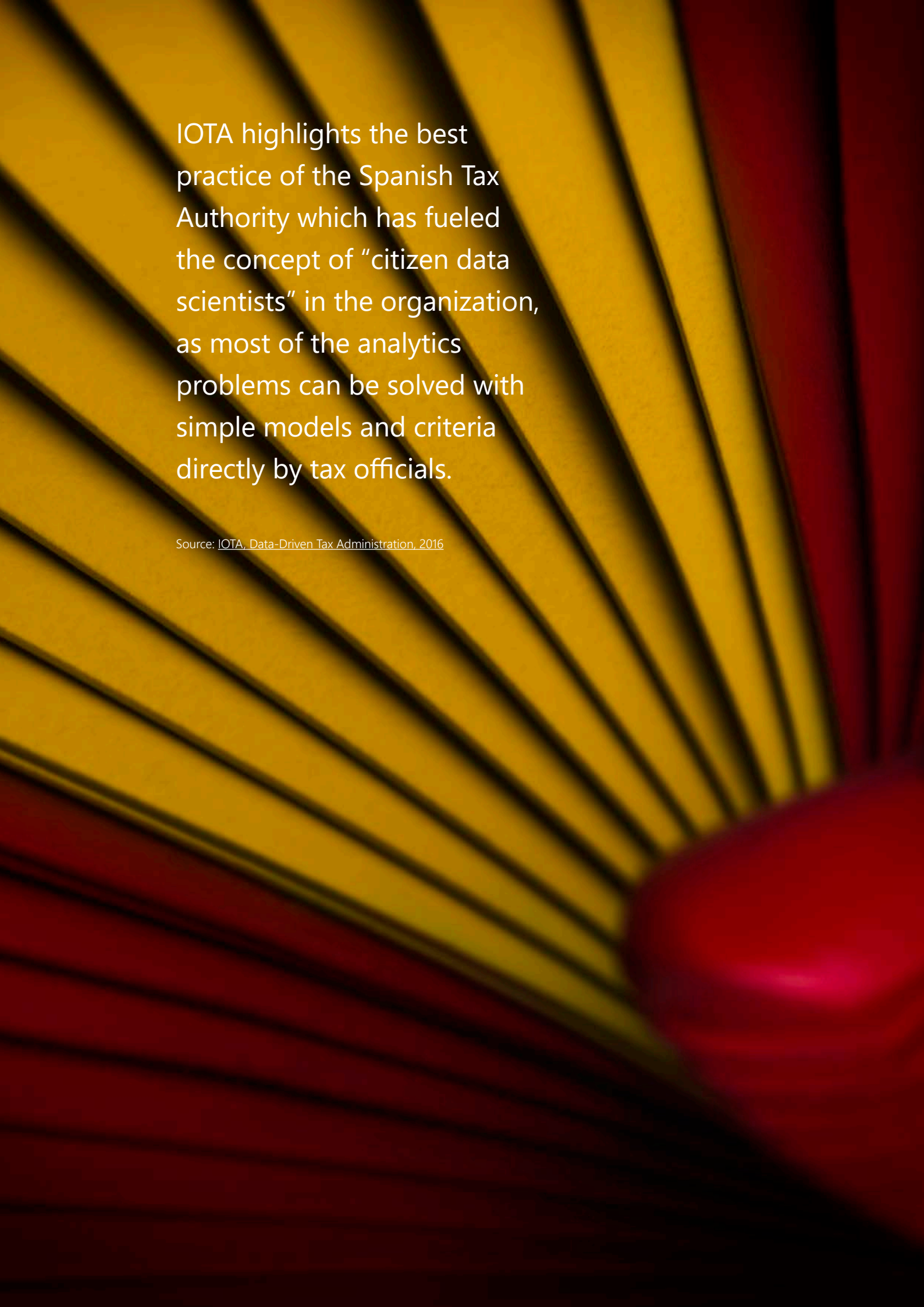
Tax administrations and businesses today compete for tax professionals with skills in new technology, Big Data management/analytics and tax risk management. Private organizations often have an advantage in this area over public administrations. To combat this, tax administrations can set up a strong ecosystem of cooperation amongst themselves, accountancy firms and academia as well as IT vendors in exchange for experience sharing, idea sharing and mutual support in building a sustainable way forward.

Such cooperation can take place between countries at an executive level led by CIOs, with a clear definition of the respective responsibilities, or with general executives of tax administrations. It can also include a better use of experts such as vendors or accountancy firms, who are keen to demonstrate the capabilities of advanced technologies as well as train and educate tax experts. In fact, vendors are closely cooperating to provide the best service in these areas where deep-understanding of processes and technology play a key role.

This white-paper, for example, comes from a collaboration between PricewaterhouseCoopers (PwC), a leader in processes for tax administrations, and Microsoft, a leading solution provider in data intelligence and AI. Finally, there can also be an active role for academia in this ecosystem to support the culture evolution.

Driving the change to a data-driven culture

Change management, training and education offers new skills as well as a highly cooperative ecosystem. Such substantial change also necessitates a change management program across tax administrations. Administrative staff need to receive proper training for the growth and extension of individual skills, abilities and competencies concerning the new operational blueprint and tax technologies, as well as understand how to best leverage these new insights in their daily work. It's also important to structure tax administrations in such a way that roles and functions are clearly defined and differentiated, lines of communication and accountability untangled and decision-making procedures transparent and functional. People must feel comfortable with technology so that they can use it as a tool to support them in their daily operations.

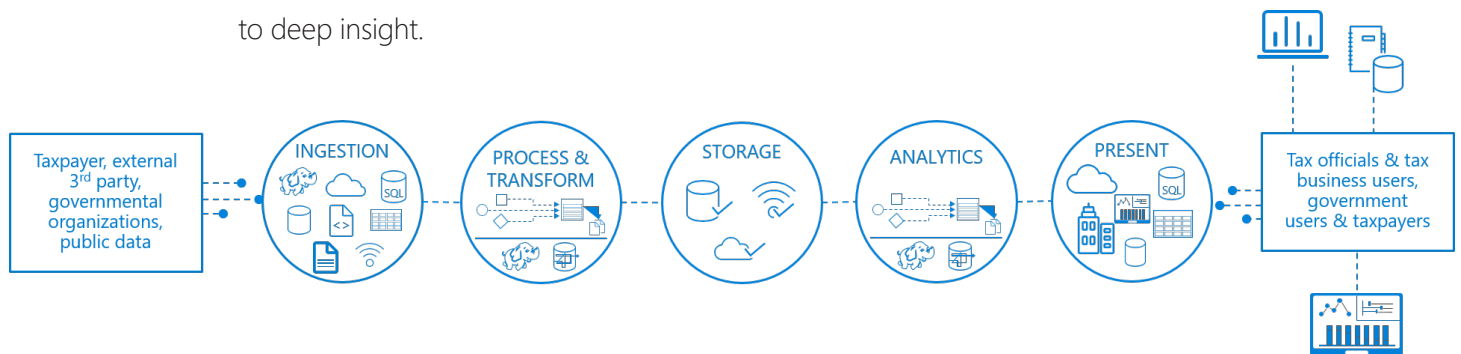


IOTA highlights the best practice of the Spanish Tax Authority which has fueled the concept of “citizen data scientists” in the organization, as most of the analytics problems can be solved with simple models and criteria directly by tax officials.

Source: [IOTA, Data-Driven Tax Administration, 2016](#)

Technical transformation

While all tax administrations face the common challenge of optimizing the value of data collected from taxpayers, they also face common issues of agility, and the ability of different audiences — tax control analysts, risk managers, planning analysts, politicians, taxpayers and data experts — to discover insight. Using technology can overcome these challenges, transforming data collection from a storage process to deep insight.



Data pipeline: from data to value

Just as water flows through city pipes into your home, data flows through the pipeline of a tax administration's infrastructure. There are five primary stages that make up this data pipeline:



Data ingestion. Cloud platforms, with their inherent elasticity and scalability, enable tax administrations to collect high volumes of data in different formats over multiple reception channels. This collection comes via two forms, taxpayer reception services on the cloud, or data fed from on-premises solutions (for highly-sensitive information).



Data processing. Processing tools enable the fast integration of information at an efficient cost. For example, data derived from commercial operations, typically captured through documents in XML or JSON formats, can be integrated with the transactional processes of voluntary compliance in a prefilled tax form.



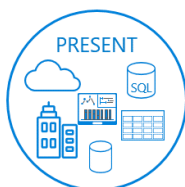
Cloud storage. To quickly make data available for use, tax administrations preserve data in its native state. This means within a cloud, data in tabular formats can be stored in tables, document-type data in document databases or file-type repositories and structural data in powerful relational databases.

- **Data lake platforms** are a subset of cloud storage — secure resources that can easily store trillions of files of all different kinds, while making it faster to get up and running with batch, streaming and interactive analytics. It includes all the capabilities required to help developers, data scientists and analysts easily store data of any size and shape and speed. In addition, people can do all types of processing and analytics across platforms and languages.



Analytical technologies. These solutions let auditors, planning analysts, risk managers and so on, use Business Intelligence (BI) self-service resources for modelling information of different lines of business. Specialized datasets get created in the processing stages or by using native data on the data lake platform.

- **Advanced analytical capabilities.** These cloud tools offer the most value, endowing tax administrations with the fiscal intelligence to reduce evasion and tax elusion. Fiscal analysts or risk managers can use them to access modern tools for predictive analysis and AI or to enable data science capabilities. They can also implement processes of detection of anomalous operations, analysis of commercial networks of purchase sale and incorrect returns, among others.
- **Stream analytics.** A perfect match for real-time auditing that detects data, during collection, that triggers recognition of a specific business rule, predefined event or action such as a notification to the taxpayer or preventive tax auditing.

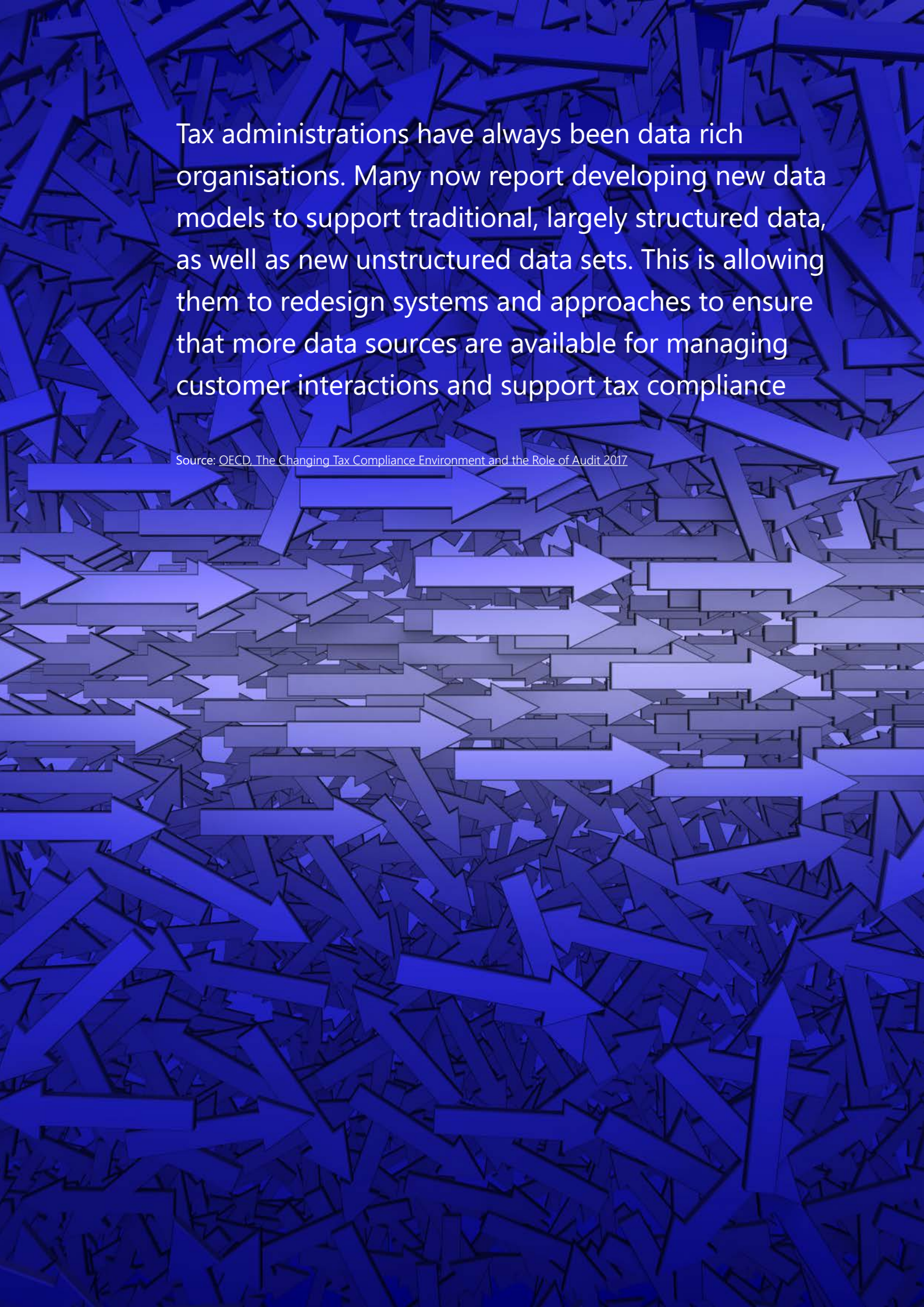


Visualization technologies. These resources, such as PowerBI, present information in an easy and efficient way with graphics and charts. You can use the modeling capabilities of PowerBI to adjust your data models and add information from other sources, such as economic or sectoral information. You can also dynamically consume reports and views or generate your own views for consumption by other users.

A **hybrid cloud approach** offers the best path to optimize your existing assets, leveraging data from on-premises and the cloud. Hybrid integration solutions let you seamlessly integrate apps, data and processes by building an application programming interface (API)-enabled and connected enterprise. This provides exceptional speed and agility that enables you to publish APIs to external and internal consumers and make apps and data easily available to stakeholders. It also creates a foundation for actionable intelligence through services like machine learning, cognitive services and data lake analytics.

Areas addressed with technical transformation

Becoming a data intelligent tax administration begins with a vision and strategy for achieving that goal. We will now drill down into three common scenarios, built from an integrated platform that enable transformation from data into actionable insights:

The background of the slide is a dense, repeating pattern of blue arrows of various sizes, all pointing towards the right. The arrows are layered, creating a sense of depth and movement. The text is overlaid on the upper portion of this pattern.

Tax administrations have always been data rich organisations. Many now report developing new data models to support traditional, largely structured data, as well as new unstructured data sets. This is allowing them to redesign systems and approaches to ensure that more data sources are available for managing customer interactions and support tax compliance

Source: OECD, *The Changing Tax Compliance Environment and the Role of Audit* 2017

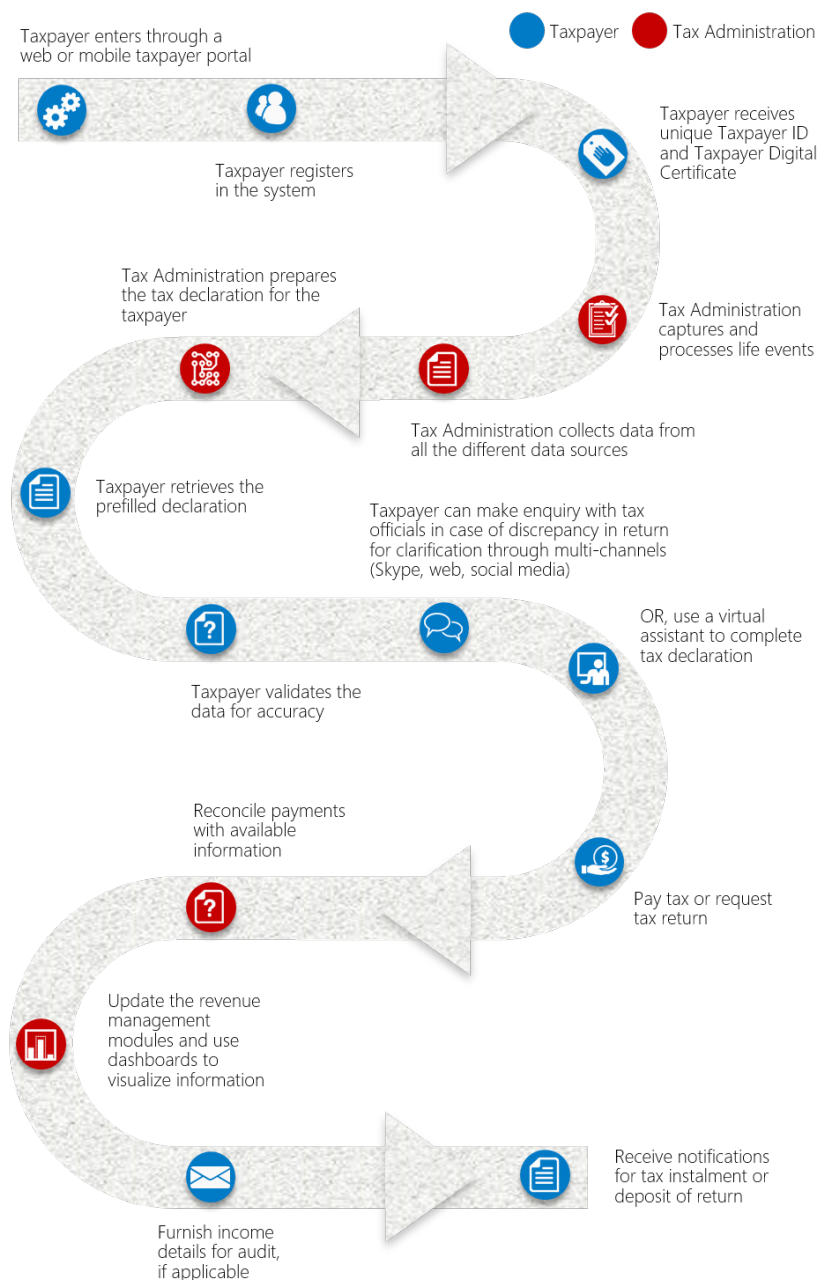
- Taxpayer expectations in a digital world
- Optimized risk detection and intelligent audit
- Improved macro socio-economic predictability to close tax gaps

Taxpayer expectations in a digital world

A data strategy can reduce dependence on the data provided by taxpayers or businesses by capturing data independently from various sources such as banks, utilities, businesses, other government entities or through devices (e.g. cash registers, gas pumps or IoT devices).

To create such a fully-rounded holistic taxpayer view requires tax administrations to have the following in place:

Taxpayer compliance journey map



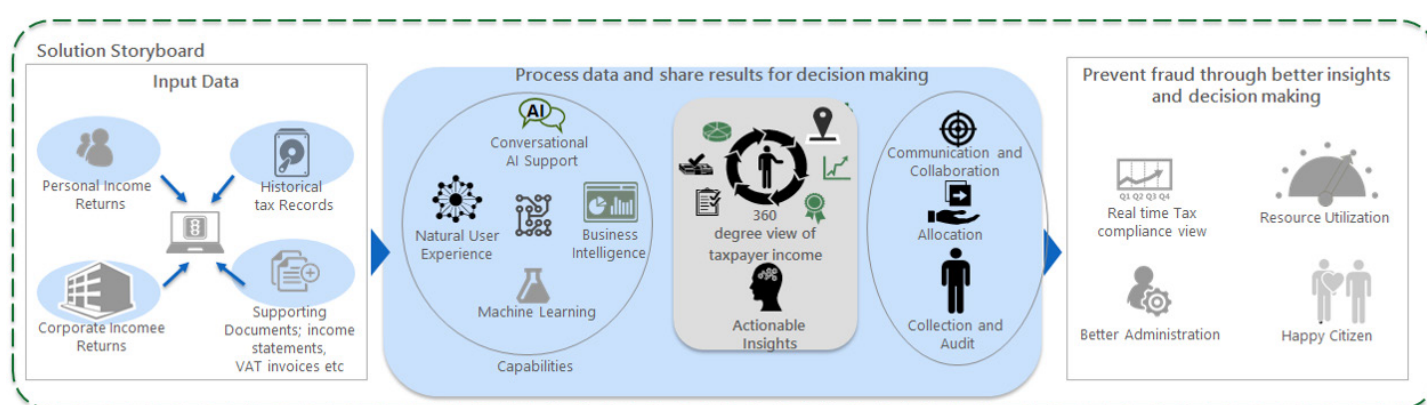


- **Data platform.** A cornerstone of a tax administration's operations needed to ensure the elasticity of the infrastructure at minimum cost. It must include modern tools, such as the cloud, in order to enable data collection and real insights. Scalability is also important for required process and storage capacity following the seasonality of tax events (e.g. tax declarations, VAT declarations) and for the exponentially growing data collected by tax administrations
- **Data standardization and optimization.** A data-enabled tax administration exchanges information with other stakeholders not only in batch mode, but also in real-time with APIs. API management, as a turnkey solution, enables the quick creation of secure, consistent and modern API gateways for existing back-end services hosted anywhere. It also protects against abuse and overuse.
- **A customer relationship management (CRM) platform.** CRM solutions help manage the taxpayer relationship from registration on, helping tax administrations build personalized experiences across all citizen touchpoints by harnessing contextual data. This leads to a complete view of citizens and the ability to draw actionable insights that can deliver personalization at scale.
- **Conversation-as-a-platform and BOTs.** CRM can be extended to taxpayer service AI, providing intelligence built on deep reinforcement learning. These learning capabilities provide frictionless human-like conversations which enable contextual dialogue. The outputs include a taxpayer-facing virtual agent that could be implemented via a bot framework

across many experiences such as Skype, Messenger, or other chat implementations and could answer questions, assist taxpayer to fill online forms and automate processes.

- **Personalized experiences.** Customized experiences increase the value to each taxpayer by delivering consistency and to-the-point communication at any channel. This requires a 360° view of each taxpayer and stakeholder that can easily be accessed and intelligently complemented.

AI applied to the above platforms will not only enable better interaction, but will also provide cross-stakeholder insights which anticipate needs and optimize policies and initiatives.

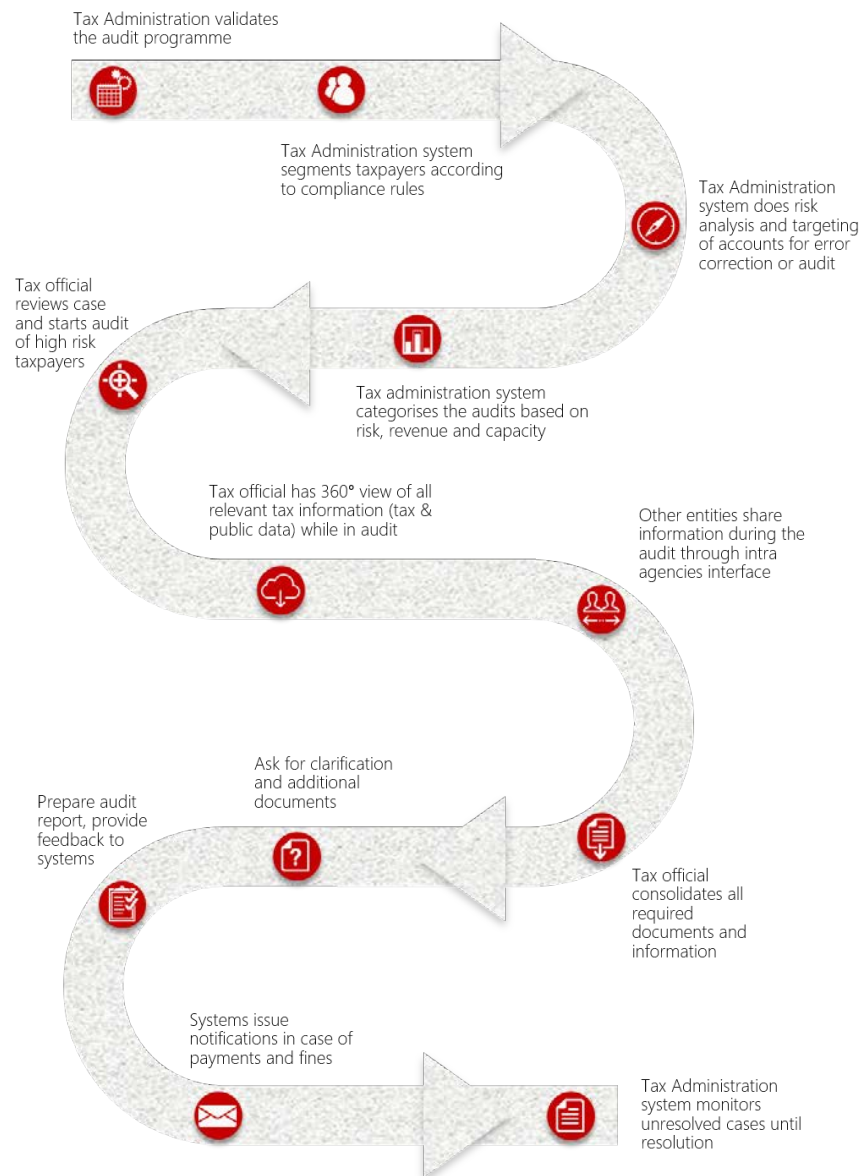


Optimized risk detection and intelligent audit

Many tax administrations have changed their compliance strategies towards risk-based auditing in light of new technologies available including data analytics tools. The ability to process a big amount of taxpayer data has enabled placing more of an emphasis on cooperative compliance strategies especially in the case of large taxpayers. Under such a model, tax administrations define their audit strategies based on the risk profile of a taxpayer. To define the risk profile, they need to assess the quality of a tax control framework, an internal validation system which provides assurance that all data in the tax return is correct and complete and taxes are paid on time.

The data needed for taxpayer performance measurement comes from available taxpayer data (e.g. corporate reporting, tax strategy and policy documents, data from tax returns, etc.), third parties, other governmental organizations and a big inflow of unstructured data. This includes multi-data from regulatory initiatives, such as OECD's [Base Erosion and Profit Shifting \(BEPS\)](#) project, Action 13. Tax administrations will need to analyze and consolidate the country-by-country reports with available tax data in order to risk-profile taxpayers. Based on the data analysis, high-risk taxpayers will demand a closer investigation and thorough audits, while medium or low-risk taxpayers will demand less audit interventions.

Intelligent audit journey map



Predictive analytics and AI can help in this realm, detecting tax gaps, fraud scenarios and incorrect tax behaviors. Some examples of this are:

- Companies paying less taxes since transferring their payroll to a third party
- Taxpayers who represent a potential risk of money laundering
- Taxpayers not paying VAT for their acts or activities that by law should be taxed
- Commercial networks between senders & recipients created to simulate economic operations
- Potential risks for taxpayer compliance with their monthly or annual tax obligations or tax evasion



Australian Taxation Office – 'Smarter Data Programme'

Australia launched its whole-of-government approach to improve decisions, services and compliance through a Smarter Data Programme in 2015. It enables pulling together data across the Australian Taxation Office (ATO) business units into a 'virtual' analytics department. Analytics staff consolidate all the data and report through a single analytics business line, while maintaining the business context of the ATO's business units.

Advanced analytics can be applied on economic data to:

- Set up rules to identify and filter fraudulent transactions.
- Search databases of known or suspected fraudsters using data matching algorithms.
- Use statistical analysis to detect cases where behavioral patterns differ from the norm.
- Identify sophisticated and well-disguised fraudulent behavior such as neural networks, decision trees, multiple regression, etc.
- Visualizing the nature of relationships between individual entities.
- Identify hidden patterns and inconsistencies in unstructured data such as claim forms or electronic invoices.

Expect more and more tax administrations to leverage more of their data to detect high-value tax evasion behaviors, new tax evasion patterns, identify organized tax evasion networks or simply reduce errors. To optimize this, they will increasingly rely on machine learning and AI.

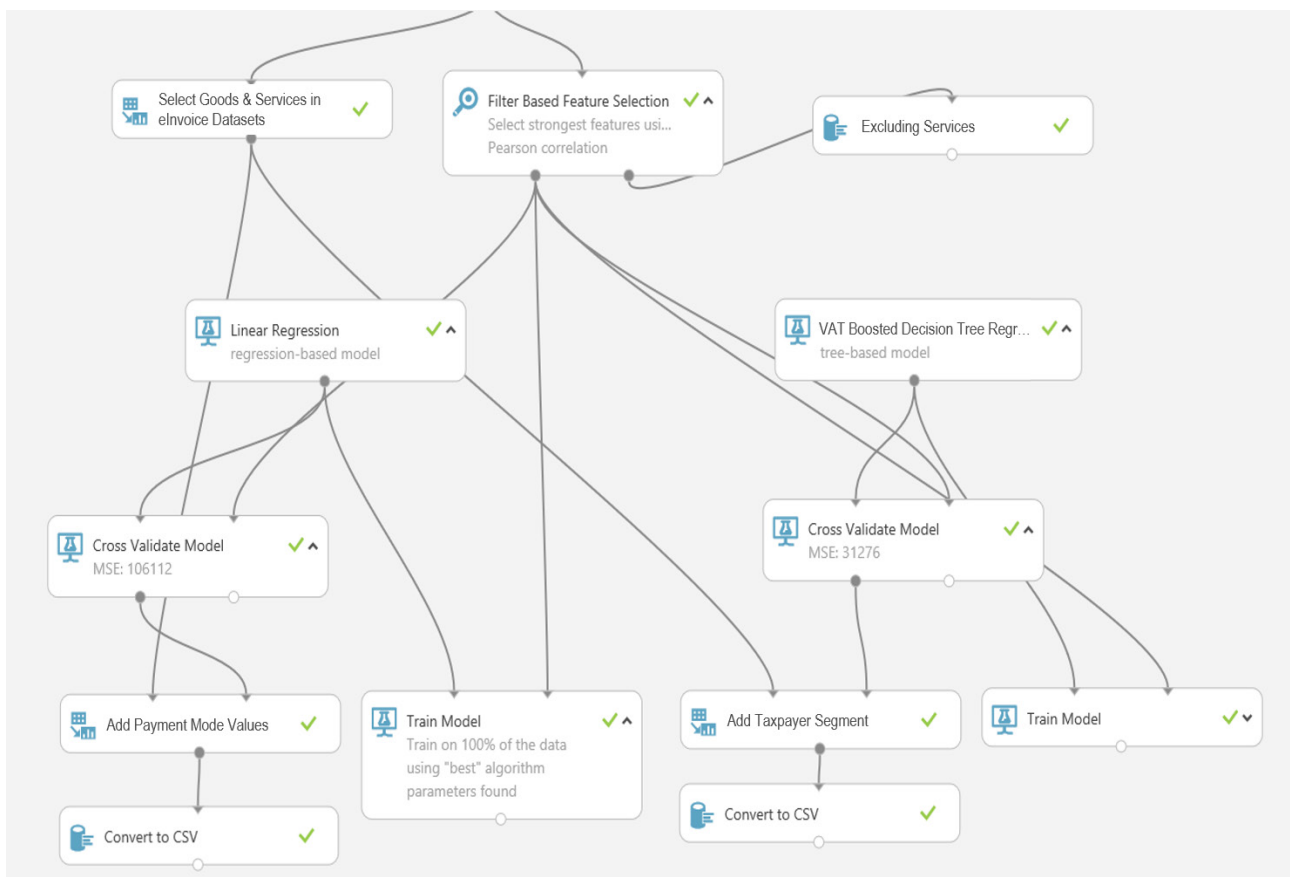
AI augments support of an Open Source Intelligence strategy, which includes unstructured information available on open sources and channels (e.g. online ads, pictures, posts on social media, networks of people) and which complements the traditional approach of fraud detection, confirms suspicious cases or highlights hidden activities and suspicious behaviours.



Tax administrations can rely on machine learning algorithms to analyze big data sets. This enables the detection of specific patterns based on historical data analysis, using a supervised model or regrouping individuals or companies in clusters using an unsupervised model. When applying machine learning algorithms, it's important to gather enough data from quality sources. Most real datasets have hidden biases. Being able to detect the impact of the bias in the data on the model, and then to repair the model, is critical.

Machine learning systems help data scientists identify which machine learning model is to be used to detect the most relevant patterns in data. To understand the pattern behind the data requires identifying the most relevant parameters leading to a fraud case. A data-driven approach enables selection of the most relevant parameters. The machine learning system helps quantify the weight of the parameters leading to fraud cases.

The machine learning model detects the most relevant patterns in the tax data. Predictive models get tested and predictive results are checked against real cases. Tax administrations can then determine an accuracy level for each model. Process and predictive models used can be mapped through a graphical interface, as illustrated below.

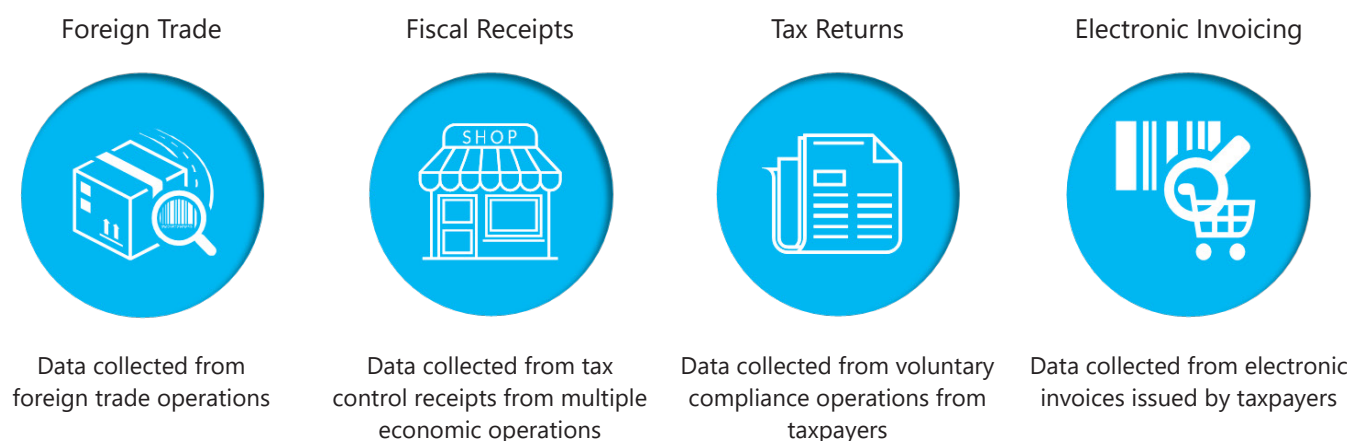


As an example, a model, called 'decision tree,' appears relevant in fraud detection cases, such as detecting simulated commercial operations or incorrect refunds of VAT. The approach is similar to the human approach to decision-making.

We first divide the population of taxpayers into two groups based on the most relevant parameter. Then, for each of the two groups, we repeat the process of finding the most relevant feature and then split the population into two sub-groups. The tree divides the population into "n" groups identifying the percentage of taxpayers in a fraud case. Applying the tree on a new taxpayer will provide a score of propensity to fraud.

Improved macro socio-economic predictability to close tax gaps

A strong data platform enables tax administrations to improve predictability of policy change output as well as a proactive anticipation of societal or economic issues or opportunities. Modeling technologies, for example, enable tax administrations to compare different policy options and their forecasted socio-economic impact, such as for lowering the carbon footprint.



Advanced analytics help tax administrations forecast revenue. Many administrations today run real-time processing and economic analysis, extracting all data of economic relevance for insight to help improve revenue management and enforce tax control policies.

Revenue management demands a deep understanding of geo-economic behavior. Predictive analytics offers a helpful instrument for revenue forecasting. For example, administrations could use regression algorithms that estimate revenues based on predicted levels of economic variables associated with revenue generation. Common subjects that tax administrations seek to address with predictive analytics are:

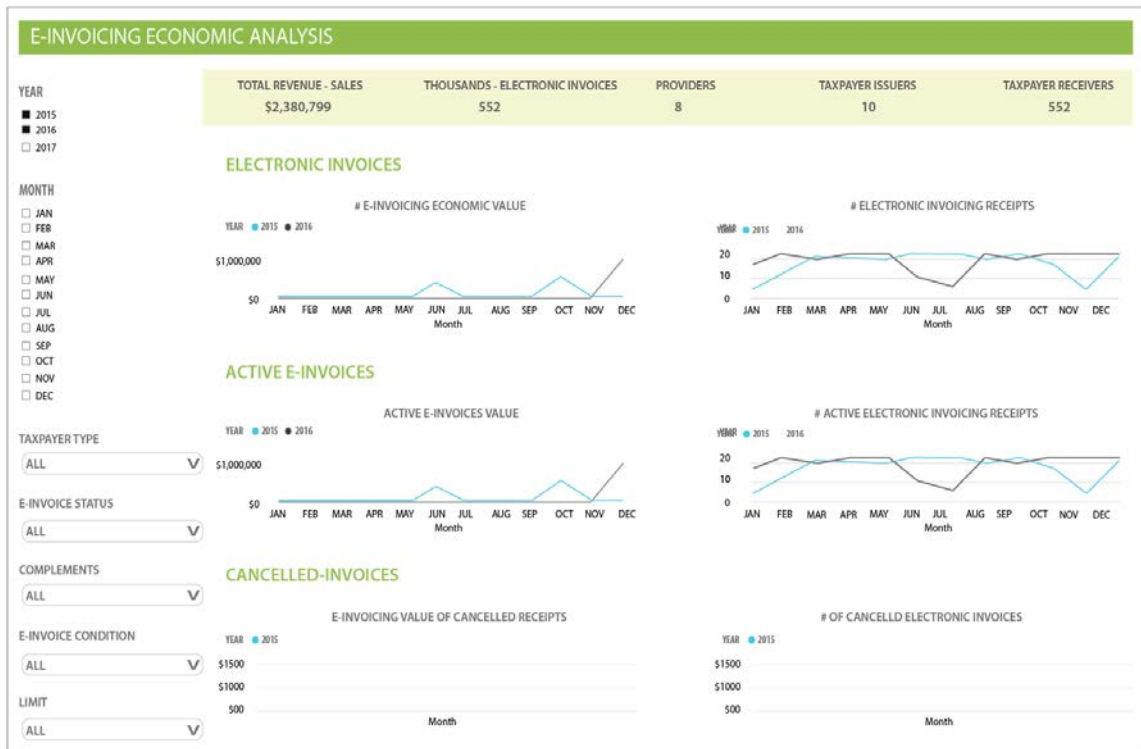
- "What-If" scenarios that consider the economic activities of taxpayers by sectors, industries, geographies, among others
- Revenue gaps from incorrect or fraudulent VAT requests made by taxpayers
- Expected revenue from different taxpayer segments and regimes, industry sectors, municipalities, states, and more.
- Expected revenue from specific sources of tax, income, property, sales and so on



Data savvy taxpayer

The amazing evolution of the digital economy, based on emerging business models and technologies, such as cloud, mobile transactions, digital payments, cryptocurrencies and so on, represent a major opportunity for tax administrations. Given the new era of mobile adoption and unrefuted progress of digital economy, tax administrations need an effective strategy to track and control the huge and increasing volume of electronic transactions and adoption of cryptocurrencies.

Advance analytics offer an effective instrument for analyzing economic data and getting a clear perspective on market insights, pricing and market performance, as well as running market simulations and risk management. Using historical data models and applying machine learning, administrations can obtain prediction models for cryptocurrencies and portfolios for market analysis. Uncovering new revenue streams from digital transactions is another interesting scenario.



Tax administrations can get valuable data from using advanced analytics to sense cryptocurrency behaviors — such as every cryptocurrency transaction, including timing, nature of spending, conditions and characteristics of commercial transactions between sender and receiver. Oftentimes, trends emerge within the analysis that have the potential to feed new business models and transform long-standing processes. Some examples of how advance analytics tools are used for supporting tax compliance are:

- Accessing and analyzing vast amounts of data residing on cryptocurrency transactions
- Cryptocurrency transaction tracing
- Verifying trends related to transactions.
- Determining transaction usage and predicting future transactions or patterns
- International transfers

If analytics is to fulfil its promise to help tax administrations make better predictions and draw more robust inferences, it needs a foundation of accurate, representative datasets that capture the full facts of taxpayer characteristics and behavior. Source: [OECD, Advanced Analytics for Better Tax Administration, 2016](#)

Conclusion



Data is the new gold for tax administrations. When they manage to implement a data-centric strategy, they can significantly improve their overall system in particular through faster compliance processes, improved taxpayer services, prevention of tax fraud and evaluation of the impact of macro-economic trends and policy changes

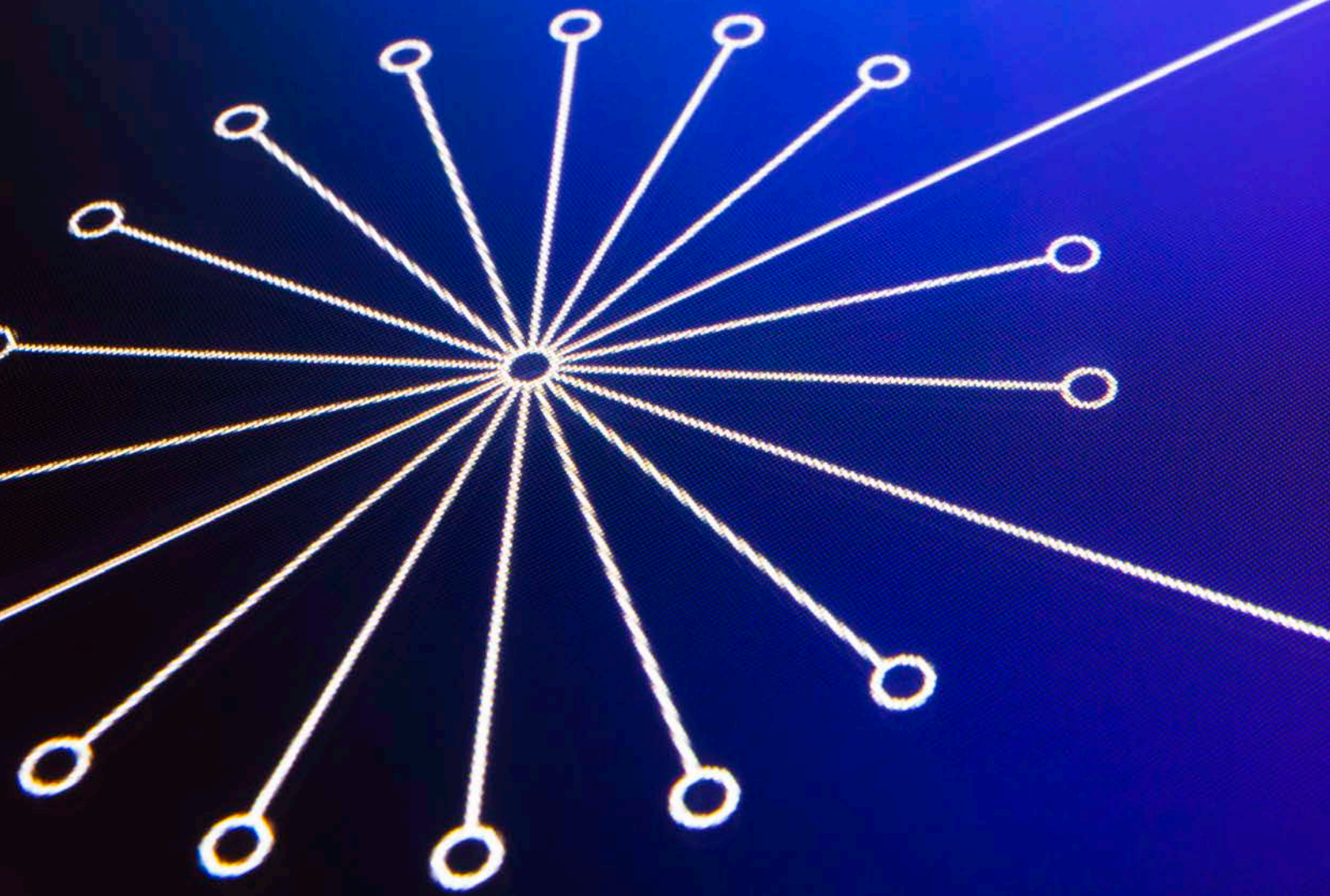
The transformation journey towards a data-intelligent tax administration is based on operational excellence and technical transformation components. Operational excellence includes a design of a tax strategy, operational and legal frameworks, proper technological infrastructure, change management and performance measurement. Technology will support transforming data collection from a storage process to the ability to provide deep insight, at every stage of the process: open data platforms and intelligent cloud technology, as well as leveraging of machine learning and artificial intelligent tools, will all contribute to this journey.

Everyone involved — policy makers, tax administrations, businesses, accountancy firms, IT vendors and academia and of course tax payers — have a role to play in enabling tax administrations to turn into data-intelligent organizations. It's not something that can be achieved in splendid isolation by tax administrations alone. Driving change towards a technology-enabled tax administration requires piloting and cooperation. This way we contribute to creating a sustainable and efficient tax ecosystem which benefits society as a whole.

"We strongly believe that investing in analytics is valuable and benefits the administration immensely. We will, in the near future, invest in Big Data know-how, Big Data environment, robotics and utilizing the data available on the internet. . . .Seize the moment, as it might be too late tomorrow - Digital economy offers challenges and opportunities to all tax administrations"

Source: [Pekka Ruuhonen, Director General, Finnish Tax Administration,](#)

[IOTA publication 'Disruptive Business Models', 2017.](#)



About the authors



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Kuralay is a core team member of PwC's Tax Strategy & Operations practice. She is focused on design and implementation of sustainable tax compliance strategies for governments, tax administrations, intra-governmental organisations, businesses and other organizations. This also includes support on digital transformation agenda, innovative audit strategies, co-operative compliance modelling, capacity building and performance measurement. Prior to joining PwC, Kuralay specialized in international aspects of corporate taxation of MNEs and conducted several research works in the field of tax policy. She holds an LL.M. Degree in International Tax Law from Vienna University of Economics and Business.



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Eelco leads PwC's Tax Strategy & Operations practice and has nearly 30 years of experience. Before joining PwC in 2007 he worked for various multinationals as head of tax, treasury, risk management and corporate finance. He supports businesses, governments, tax administrations, intra-governmental organisations and NGO's in their endeavours to design and implement sustainable tax compliance strategies. As part of this process, he advises on and implements solid foundations for ameliorating tax compliance infrastructures by building performance measurement systems and innovative audit strategies. He is a lecturer at various European universities, Chairman of the Tax Policy Group of Accountancy Europe. Eelco has published more than 40 articles on tax governance and is chief-editor of Tax Assurance Magazine.



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Raúl is a Tax and Government Digital Advisor and a Microsoft world-wide tax community champion supporting the digital transformation journey for the Microsoft Latin America region and many tax organizations around the world. Raúl's deep understanding of the tax and revenue industry, especially for developing economies, has contributed to the transformational success of Mexico's Tax Authority including development of Microsoft Tax IP and presenting at industry conferences internationally. Raúl has extensive experience in IT, Government and Tax and delivers strategic consulting to governments and private sector organizations. Raúl is an MBA with a finance specialization, graduated from the Universidad de las Americas, and Instituto Politecnico Nacional in Mexico.

About PwC

At PwC, our purpose is to build trust in society and solve important problems. It is this focus which informs the services we provide and the decisions we make. Demonstrating genuine leadership is more important to us than size or short term revenue growth. To achieve our aim to be recognised as 'the leading professional services firm' we must be innovative, responsible and attract outstanding people. Our strategy is therefore built around five priorities:

1. be technology enabled;
2. deliver exceptional value to our clients;
3. empower our people;
4. lead by example;
5. invest in sustainable growth.

Attracting the right talent continues to be paramount and as a progressive employer we will continue to develop a diverse and agile workforce.

About Microsoft

Microsoft is the leading platform and productivity company for the mobile-first, cloud-first world, and its mission is to empower every person and every organization on the planet to achieve more. Our vision for government organizations is to enable them to better serve and protect citizens and build more secure, productive nations by connecting people, systems, and information resulting in more impactful outcomes.

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